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Utility

■ First Looks:
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► After Hours:
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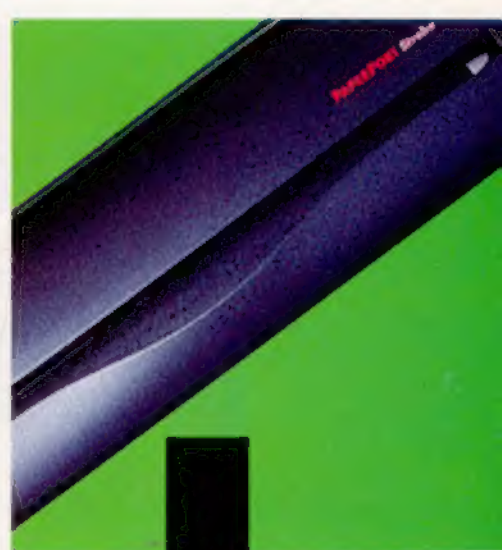


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THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOL. 17 NO. 8 APRIL 21, 1998

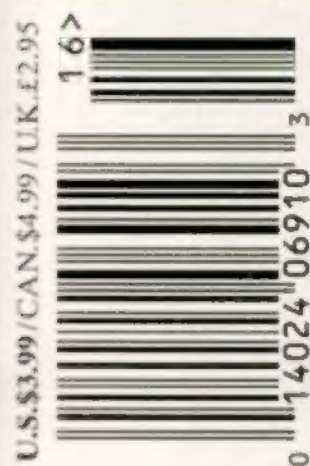
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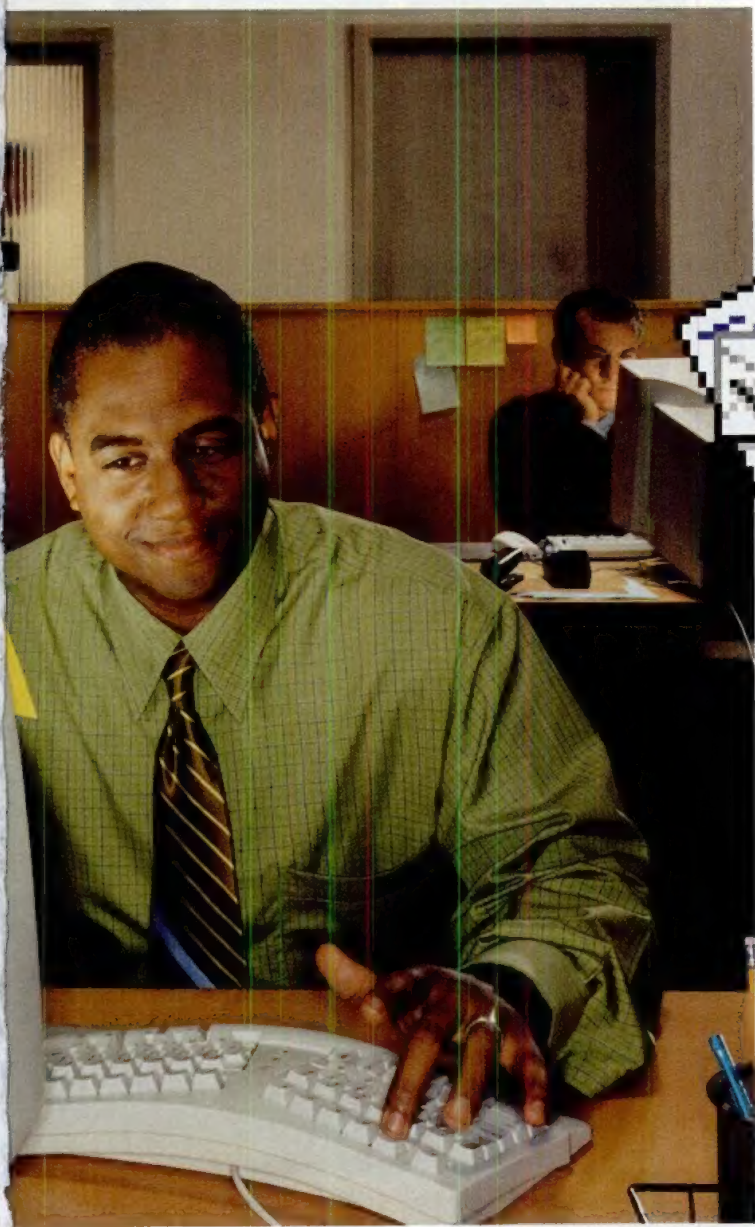
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Regulation: Not *If* but *How*



When the Senate Judiciary Committee recently called Bill Gates, Jim Barksdale, Scott McNealy, and others to Washington to testify about Microsoft's role in the software industry, you knew it was an event that would generate more heat than light. And in that regard at least, the testimony was everything you'd expect.

All the presenters came off as intelligent, well-coached, and well-prepared men. And they were all there not in any great service of the public's best interest but in their own interests and in the interests of their companies and stockholders.

The grandstanding extended to the other side of the table as well, when we heard senators routinely ask questions they already knew the answers to so that they could look good. If this is government in action, no wonder so many people in the computer industry distrust the government.

Bill Gates was questioned again on whether Microsoft had a monopoly over PC operating systems. No kidding. To make the point, Netscape's Jim Barksdale asked the folks in the room who had a PC. Lots of hands went up. Then he asked who ran an OS that came with Internet Explorer. The same number of hands went up. Not a hand remained. That, Barksdale said, is a monopoly.

Barksdale's right. Microsoft has an effective monopoly on PC operating systems. He knows it, Bill knows it, and all the senators know it. So do all of us who buy PCs. And most of us don't mind as long as we're getting the platform that runs the most software and does so as well as any other OS does. And Microsoft will keep its position—unless someone comes along with something that is better or different enough to make us want to buy something else.

The anti-Microsoft group was equally self-centered, saying it wanted a level playing field. This group doesn't want government regulation in the software business—unless, of course, Microsoft is the one being regulated. And since Microsoft's size and market power get in the way, this faction at least wants Microsoft slowed down.

Nothing wrong with that, but this is a long way from saying that you don't want any government regulation. Obviously this group wants its companies to succeed, and it wants all the opportunity that comes with a regulation of Microsoft.

The questioning from the senators, along with the recent posturing from the Department of Justice (which is considering a broader antitrust

case) leads me to believe that this "investigation" is far from over.

Many people see Microsoft as having too much power and being able, all too easily, to take its position in operating systems and apply that to other areas of the computer industry. And there's little question, upon listening to the senators' questions, that most won't be satisfied until the government finds a way to limit Microsoft's influence.

But I find it interesting that this is happening now, just when the argument that Microsoft's dominance leaves no room for other software platforms is being challenged in the marketplace. For instance, Microsoft has spent millions establishing its Windows CE operating system for hand-held devices. But while CE is still waiting for critical mass, more than a million people have opted for PalmOS, from Palm Computing (a division of 3Com), as implemented in the new Palm III, PalmPilot, and compatible devices.

But like it or not, the government can fight this case for years, and even if the government doesn't win, the scrutiny will force Microsoft to act differently. Sooner or later, Microsoft will be forced to decide to accept a set of more stringent regulations that it feels it can live with. Regulation will make business easier for Microsoft's competitors, though I have my doubts that this will result in better software or better bargains for consumers.

The question that remains is not *whether* Microsoft should be regulated. The question is *how*.


MICHAEL J. MILLER

INTRODUCING A WHOLE NEW

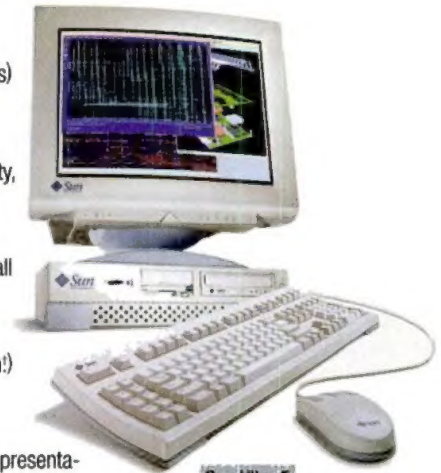
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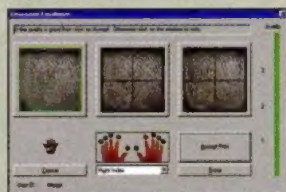
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COVER STORY

HOT PRODUCTS: 160 ESSENTIAL HARDWARE ACCESSORIES

Is there anybody who doesn't love all those little extras that you simply must have right at your fingertips along with your PC or laptop? We've got dozens of great little "necessities" in a variety of categories. Surely you need at least one or two? We thought so!100

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PCs

Should You Upgrade Your PC or Buy New?

BY CADE METZ

Are you feeling compelled to purchase a new PC with every new wave of CPU technology that comes along? We pitted some nicely upgraded 486 systems against some of the latest Pentium PCs coming off the block, just to see what happens. Some of our results may surprise you....137

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HARDWARE

Removable Storage: Your 22 Options

BY M. DAVID STONE

Interesting that something like removable mass storage has finally moved into the mainstream consciousness. It says plenty about how far computing has come. In this roundup, we go through all your options and help you choose which technology—then which product—is right for you153

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Introducing the 17 inch (16.0" viewable)

The GS771 redefines sleek.

The new GS771 is ViewSonic's smallest 17" (16.0" viewable) monitor. In fact, its compact footprint takes up less desktop space than a conventional 14" monitor.

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Pipeline



Ma Internet

Soon you'll be surfing the phone and talking on the Web. Internet telephony has had a shaky start, but the computer and telecommunications industries' biggest players are clamoring to participate in what many are calling a revolutionary shift in how we make phone calls.

"IP [Internet Protocol] is to the communications industry what the PC was to the computing industry," says Dan Schulman, president of AT&T WorldNet. "IP opens doors for applications for customers that they've never even thought about."

The opportunities could be awesome. In 1996, revenues for the Internet telephony market reached \$19.8 million, according to consulting firm Frost & Sullivan. And revenues are expected to reach \$1.89 billion by the end of 2000. Market research firm International Data Corp. predicts as many as 16 million Internet telephony users by 1999.

Among the innovative telephony applications that developers are now cooking up is one from AT&T that will manage a multiparty, multimedia conference call. Available in May, the software will enable call participants to use telephones or PCs to "co-browse" the Web simultaneously. The application will let family members planning a vacation sit at their desktops—Dick at home, Jane at the office, Sally and Johnny at school—and view Web sites at the same time while they discuss destinations.

The Atrium Suite, from Vocaltec, offers similar functionality. Using the suite's Internet Conference Professional, multiple users can collaborate on an application or a document, such as a PowerPoint presentation or an Excel spreadsheet.

Although some analysts predict a booming market for Internet telephony, others contend that the economic incentive to use voice over IP will dissipate in the next five years because Internet-access charges are climbing while phone rates are declining.

Gates Heads for Outer Space

Late one night in February, 39,000 feet above the Pacific Ocean, an L-1011 aircraft released the Pegasus rocket, which delivered the first test satellite in the Teledesic Internet-in-the-Sky network into orbit.

Backed by cellular phone pioneer Craig McCaw, Microsoft



READY FOR TAKEOFF: The launcher and the satellite (inset).

CEO Bill Gates, and Boeing, the \$9 billion, 288-satellite system is designed to provide worldwide wireless telecommunications services, including broadband Internet access and videoconferencing, at data rates of 64 Mbps on the downlink and up to 2 Mbps on the uplink. One of Teledesic's *raison d'être* is to provide telecommunications services to parts of the world where installing land lines isn't economical. Today, advanced telecom infrastructure is limited to developed urban areas, leaving most of the world's population without access to basic services. Service is slated to begin in 2002.

Speak Up

Slowly but surely, voice-recognition technology is showing up in applications that go beyond dictating a word processing document or navigating through menu options in Windows. Two examples are E*Trade, which now offers voice-automated stock trading, and Conversá, which lets you browse the Web via verbal commands. You can expect more voice-

enabled applications to appear on the scene this year.

Dragon Systems, developer of the voice-recognition program

NaturallySpeaking, is packaging its technology into ActiveX controls and making them available for application developers. One of the first to integrate the control is Actioneer, which plans to ship voice-enabled contact managers for Microsoft Outlook, 3Com's Pilot, and Lotus Notes later this year.



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The Latest Upgrade Strategies

This issue's story on upgrading your PC continues online, where we present step-by-step instructions.

New in the Virtual Labs

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News Junkies Prefer CNN Interactive

60%

of respondents to a recent PC Magazine Online poll reported that the online news source they turn to most often is CNN Interactive. ABC News and MSNBC tied for distant seconds, at 18 percent each.

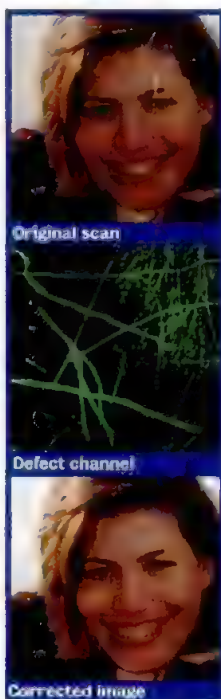
Pipeline

Out, Damned Spot!

If you've ever tried to use image-editing software to restore a photo that's badly damaged by scratches, fingerprints, and dust, you know how painstaking the process can be. Now, Applied Science Fiction, based in Austin, Texas, has come up with an inventive technology that automatically erases surface dust, blemishes, scratches, and fingerprints from scanned images.

Called Digital Ice, the software scans the surfaces of the film or photo, recognizes anything sticking up or gouged into the surface, and creates a fourth data channel for defects, in addition to the RGB channels.

In demonstrations, the software removed dust, scratches from paper clips, and gum left over from tape on the film—by literally wiping them all away. When you click on an on-screen button, a bar slides down from the top, much like a windshield washer's squeegee. Applied Science Fiction is licensing the technology to film and photo scanner makers. One of the first scanners to incorporate Digital Ice is Nikon's new CoolScan LS 2000 film and slide scanner.



MAKEOVER: Digital Ice automatically wipes away surface defects.

Web Ads Hit Their Stride

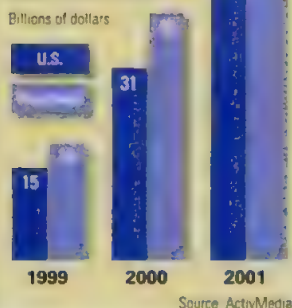
Advertisers are starting to wake up to high-income, educated Internet users. After years of missed projections, Web advertising is finally hitting its stride, with broad economic implications. By

ing to market research firm ActivMedia. That translates into global ad revenues of \$19 billion in 1999 and \$59 billion by 2001.

A big factor in this staggering growth spurt is advertisers' realization that Web demographics are very skewed toward educated, high-income people, says Microsoft chief operating officer Bob Herbold. "About 65 percent of Internet users have incomes of at least \$40,000 per year, and over 90 percent of Internet users have some college experience," he says.

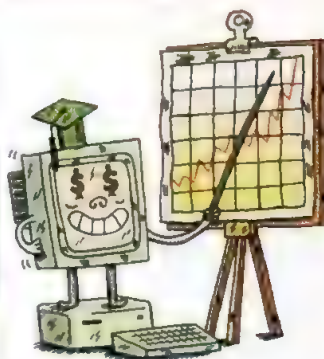
The rapid growth in the number of Web-connected homes is also responsible for these ad fortunes. According to Microsoft data, over 22 million households in the United States are connected to the Internet, representing a growth rate of 80 percent over a year ago, a growth rate which Herbold warns "has to slow down."

Projected Web Advertising Revenues



the year 2001, Web ads will represent a whopping 11 percent of all global ad revenues—up from about 1 percent in 1997—accord-

THIS ISSUE'S CONTRIBUTORS: Angela Hickman, Carol Levin, Sebastian Rupley, and Don Willmott.



Brainiac Software

Now that the Internet and corporate intranets have ushered in an age of data overload, figuring out how to use it all in an efficient and productive way is the new challenge. One possible solution: ultrapowerful decision-making software.

Neural Applications, an Iowa-based software developer, is taking a stab at the solution with neural-networking software. The program learns the characteristics of processes by historical observation of trends and adapts its modeling strategy for precise prediction. In other words, the software crunches historical data in order to predict future outcomes of similar events.

NetProphet, a Java-based financial charting tool from Neural Applications, uses the technology to target buy/sell entry and exit points for stocks on a daily basis. According to the company, the neural network engine runs at a speed equivalent to a 16,000-MHz Pentium.

Top Selling CD-ROMS

- 1 TurboTax 97 Intuit
- 2 TurboTax 97 Deluxe Intuit
- 3 TaxCut 97 Block Financial
- 4 VirusScan McAfee
- 5 Windows 95 Microsoft
- 6 Norton Utilities Symantec
- 7 Quicken Deluxe 98 Intuit
- 8 Acrobat Capture2 Adobe
- 9 Quicken Basic 98 Intuit
- 10 Myst Broderbund

Source: Computer Intelligence/Infobeads, Data for January

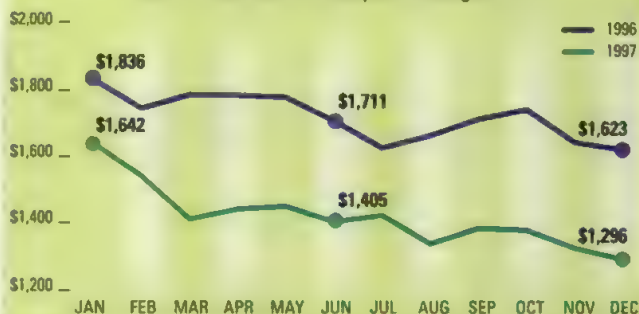
Forget Showercaps

The Internet is giving a whole new meaning to hotel amenities. Microsoft and Atcom/Info, a San Diego-based developer of Internet kiosks, recently launched Iport, a high-speed Internet access service that lets guests bypass the hotel's phone system and connect directly to an ISP over a high-speed line—ADSL, ISDN, or T1.

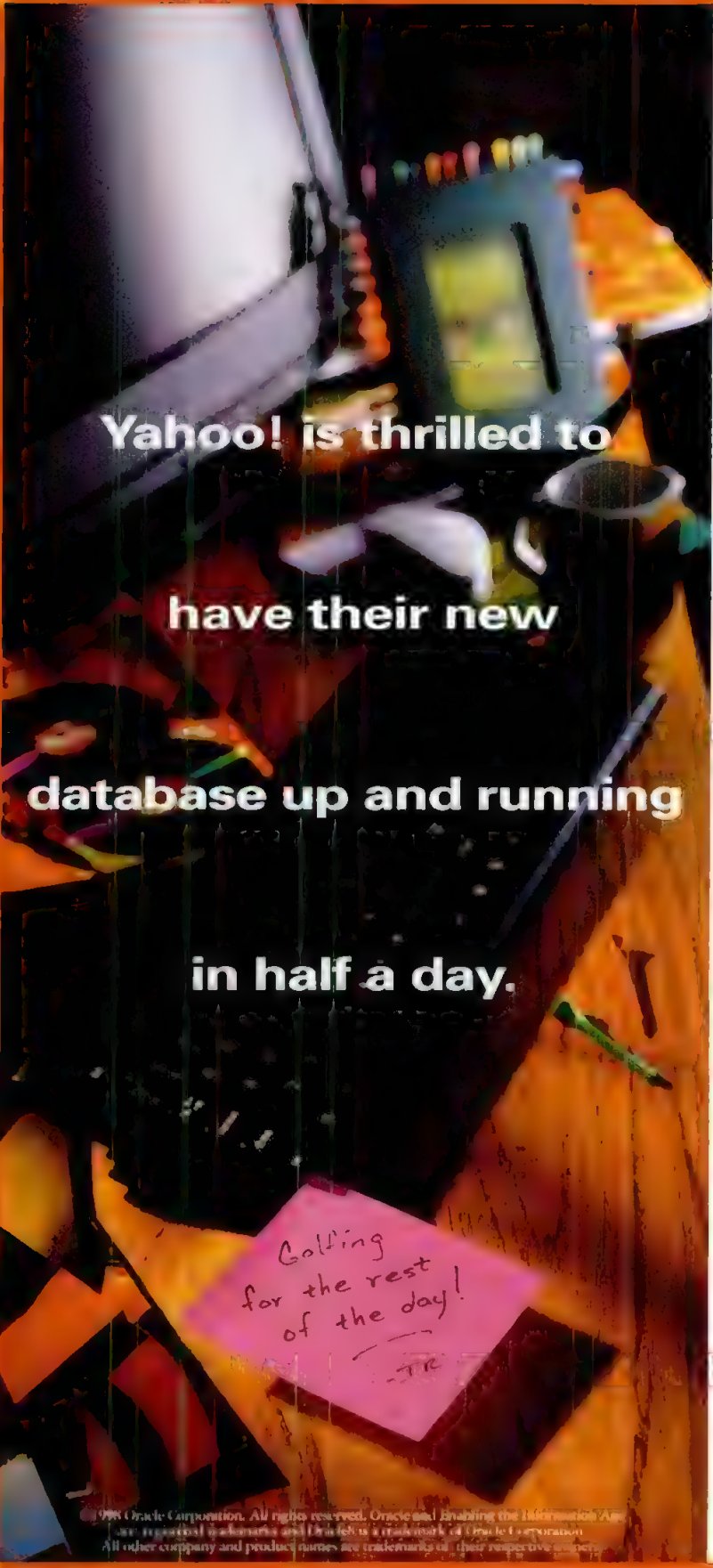
Five hotels, including the Hotel Vintage Park in Seattle and the Washington DC Marriott, are currently running trials.

PC Prices Plummet

On the average, desktop PC prices have declined more than 20 percent since January 1997, after a period of slower decline in 1996, according to market research firm Computer Intelligence.



Source: Computer Intelligence, 1998



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for the rest
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BATHING SUIT.

AT 720 DPI
YOU SEE HER BATHING
SUIT IS WET.

YOU'VE GOT TO SEE IT IN

EPSON

COLOR.



AT 1440 DPI
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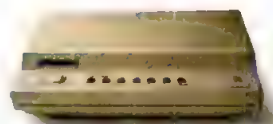
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Letters

TAXING

Your review of tax preparation software (After Hours, February 24) would have been more useful if you had mentioned that your Editors' Choice, TurboTax Deluxe, does not run under Windows NT. Last year's version did. With no access to a Windows 95 machine, I was forced to run the program under Windows 3.1. The current version of the program has a severe bug, which causes problems if you are importing more than one W-2 form from the previous year's TurboTax file. The service representative at Intuit knew all about this and walked me through a fix, but it taxes one's credulity to think that the vendor could release a program with such a bug.

NORMAN S. CLERMAN
via the Internet

Buried within Intuit's TurboTax Web site, I found a reference to Windows NT being neither tested nor supported "due to limited consumer demand for the platform."

IGOR FIRKUSNY
Brookline, Massachusetts

The reviews of tax software were written for the After Hours section with the home market in mind. Very few consumers in the home market run Windows NT, so the products' ability to run under that operating system was not part of our criteria for this story.—Ed.

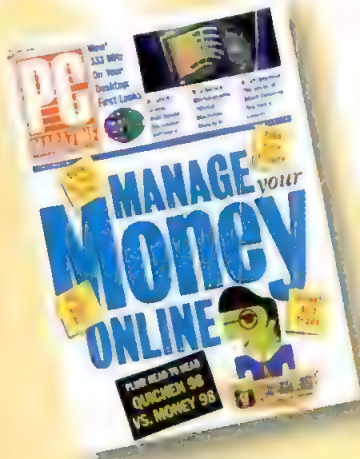
COSTLY ONLINE BANKING

Your articles about online banking ("Personal Finance on Your PC," February 24) were very informative. However, there are still some problems with online banking. I spent four months overseas and used Quicken to pay my credit card bills. It worked, in the sense that the bills got paid on time. However, calling Quicken to send the payment instructions costs \$5 each time, at international phone rates. Until banking can be done securely on the Internet—at no more cost than a postage stamp—online banking won't really be "here."

JOE MARTINO
via the Internet

LIMITED COMPARISON

I concur with your opinion that handling my finances is the most important use of my computer ("Money 98 vs. Quicken 98," February 24). I retired ten years ago at the age of 65. Making my money last is my main job. What I disagree with is the conclusion that the best software to use is limited to Microsoft Money and Intuit's Quicken. I am using a DOS program, Version 11 of Managing Your Money, by MECA Software, and find that I can do all that is attributed to the programs of your



"You should have mentioned that TurboTax will not run under Windows NT."

choice, which require Windows 95. To date, I do not use Windows 95, and doing the finance chore will not convince me to switch.

GEORGE LINER
via the Internet

I agree with you that Quicken 98 is an incremental improvement over its previous version, albeit with some minor disadvantages. Unfortunately, you didn't mention the abysmal technical support Intuit now offers. Gone are the days of toll-free support, and Intuit hasn't yet discovered the Internet as a means of customer support. I have spent more on long-distance calls to tech support than I spent on upgrading to Quicken 98. I've been a Quicken and TurboTax user for nine years and was a beta tester for previous versions, and I used to be their biggest proponent. I'm not going to spend any more money on long-distance calls to Intuit. It's Microsoft Money for me.

JAMES A. JOHNS
Nashville, Tennessee

COLLAPSE ON THE HORIZON

John C. Dvorak's "Will the PC Market Collapse?" (February 24) was on target. Because of the difficulty in upgrading to a new PC under Windows 95, only two scenarios are possible: Either someone will develop a utility that permits seamless, automatic upgrading under Windows 95 or else the upgrade market will evaporate, leading to an eventual collapse of the entire PC market. I have a ten-month-old 200-MHz MMX system and have the resources and the desire to upgrade tomorrow. But there is not the slightest chance that I will

upgrade if it means I will have to install and reconfigure the 100-plus applications on my system—not even for a 1-GHz system.

RICHARD H. EBRIGHT
New Brunswick, New Jersey

Dvorak has hit on a very important concept in this maturing market, although *collapse* may be too strong a word. Perhaps a division of the market into practical segments is the phenomenon we are seeing. That phenomenon will have a strong economic impact on manufacturers and will slow growth significantly for a while, as software and infrastructure develop to the point at which most ordinary users see a genuine need to upgrade to much more powerful computers. (By way of background, I started with a TRS-80 in 1980 and have regularly upgraded home and office machines every few years.) Also, Dvorak is absolutely right about the hassle of reinstalling everything on a new machine.

Now that computers are in such wide use, the market will probably divide itself into segments of various needs. For many of us, a home computer running Windows 95 on a moderate Pentium PC is adequate for most office use. Overall, I don't find most folks need or can justify super machines.

BOB MARTIN
Albuquerque, New Mexico

HIDDEN AGENDA

Dvorak (Inside Track, February 24) is absolutely right when he speculates that the government's hidden agenda is the importation of more foreign engineers and programmers. I was laid off a year ago after 24 years with a multinational company. I had mainframe and PC experience, but the people my employers kept were from federal job-training programs and had 6 months' to 1 year's experience. Even as they were laying off the older (higher-paid) workers, they were hiring new workers just out of college.

TOM ELKINS
via the Internet

LEFTY TECHIES

Jake Kirchner's February 24 column ("Left-Handed Computing: A Sinister Plot?") asks why there are so many left-handed people in high-tech industry. I can't answer for anybody else, but I used to be right-handed until carpal tunnel syndrome took its toll after 15 years in the industry. So I switched to being a lefty. Maybe others have made a similar switch because of computer-related injuries. I'm hoping that voice recognition will be widely available by the time my left hand packs up.

STEVE DIXON
via the Internet



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IMATION

Letters

CORRECTIONS AND AMPLIFICATIONS

I've read references to studies showing a significantly higher percentage of left-handers in technical fields than in the general population. A glance around most meetings at my former employer's (a scientific research company) would reveal 30 to 50 percent taking notes left-handed. Left-handed computer users should do as I do and work the mouse with the right hand, leaving the left hand free to write and do other useful things.

I'm always surprised that right-handed people put up with the handicap of using a mouse in the same hand they have to write with. The industry doesn't cater to left-handers, nor should it. Our problems are the same as everyone else's.

ERIC GREENWELL
via the Internet

ISA-LATION AND PC98

Jim Seymour said in his February 24 column ("PC98: Turning PCs Upside Down"): "We're finally getting rid of the slow, clumsy, 14-year-old Industry Standard Architecture bus!" Yeah, and I suppose that everyone with proprietary interface cards will just throw their scanners away, along with their sound cards and modems. Perhaps someone will design a little box to hook up to the USB port that would allow us to use our ISA cards. I suppose Creative Labs could come up with PCI versions of their SoundBlaster and ModemBlaster cards. And there are always external modems, with their extra power packs and cables. No, I don't think we'll be getting rid of the ISA bus anytime soon.

STEPHEN ASHTON
Las Vegas, Nevada

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The following statement appeared in "Inside PC Labs: The Dual Chip Decision" (Trends, February 24): "A multithreaded OS—such as Windows NT 4.0—uses a multiprocessor kernel that automatically balances the load between the processors." It should have read: "Some PC operating systems, such as Windows NT 4.0, use a multiprocessor kernel that automatically balances the load between the processors."

In "Diagnose and Repair Your Web Site" (February 10), we erred in classifying TetraNet Software's LinkBot Pro 3.5 as a shareware package. LinkBot Pro is a commercial package, retailing for \$249.95 and available through www.tetranetsoftware.com.

In our February 10 feature on digital cameras ("Digital Cameras: Crossing the Threshold"), we indicated erroneously that the Ricoh RCD-2E includes a built-in flash. The camera does not have a flash; however, it does offer automatic exposure and automatic white balance for indoor shots.

In the January 20 edition of Abort, Retry, Fail?, we incorrectly attributed a picture of a monitor on which an image of cheerleaders was displayed to EDN magazine. In fact, the image was from a Tektronix ad that appeared in EDN and had nothing to do with EDN's editorial staff.

Anyone who provides technical support longs for the day when the industry drops the ancient ISA bus for an all-PCI-based system, as Seymour suggests. However, it is not backward compatibility that forces consumers to stick with the ISA bus—it's the lack of PCI-based add-in cards in many categories. While video, network, and SCSI adapters have been available for some time, where are the PCI-based internal modems, or even a simple PCI-based I/O card for an extra parallel port?

JAMES K. JOHNSON
via the Internet

I agree with everything Seymour said about the PC98 standard. He did, however, leave out some of the not-so-nice parts. For example, the *PC98 System Design Guide* (Microsoft Press) states, "Internal system modification capabilities are not accessible to end users" (item 9, page 38). That is not actually a requirement for compliance with the standard, but simply a recommendation. However, hardware manufacturers will try to comply as much as they can with the design guide. The section goes on to state, "Upgrade capabilities for RAM and CPU are not end-user accessible" and describes "lockable or sealed-case design, where internal expansion capabilities are not end-user accessible." So let's say a friend of mine buys a computer and a couple years later decides he needs 96MB RAM instead of 64MB. He won't be able to open up his case and pop in the new RAM—something I have been doing for years and don't plan on stopping. If I own the computer, I should be able to do whatever I want with it.

ADAM BATKIN
via the Internet

MICROSOFT STIFLE 98

Although Michael J. Miller's editorial "Software-a-Rama" (February 24) might be on target regarding software in general, it truly misses the mark with respect to browsers. Microsoft has in effect stifled any new devel-

opment in the browser arena. By giving away its Internet Explorer for free, the company has effectively eliminated any meaningful competition. No one else will invest the money required for research and development on new browser software if they have to give it away without realizing a profit.

JIM FRAZIER
via the Internet

I certainly don't know the "people" who "suggest that all the innovation in software has been reduced to that coming from Microsoft," as Miller says. Microsoft's success is based on profitably adopting, adapting, and exploiting innovations of others. It goes all the way back to Falcon DOS. Probably the most recent example is Microsoft's announcement that the company will include HTML read, write, and edit capabilities in the next update of Word and Office.

ED UNGER
Houston, Texas

DO CONSUMERS REALLY WIN?

Bill Howard mentions in his February 24 column ("Integration or Segregation?") that customers are the winners of the browser wars, because they get great new software free or nearly free. However, there is a large hidden cost that is often overlooked. When Microsoft released IE, it was somewhat but not fully compatible with Netscape's then de facto standard, Navigator. As a consultant involved in large Web development projects, I can attest to the fact that programmers and HTML authors spend huge amounts of time trying to make programs and pages behave similarly under both IE and Navigator. The total cost to U.S. business, measured in additional programmer time and lost productivity as a result of IE's existence, is in the hundreds of millions of dollars, which undoubtedly gets passed on to consumers.

DYLAN TYNAN
Austin, Texas

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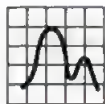
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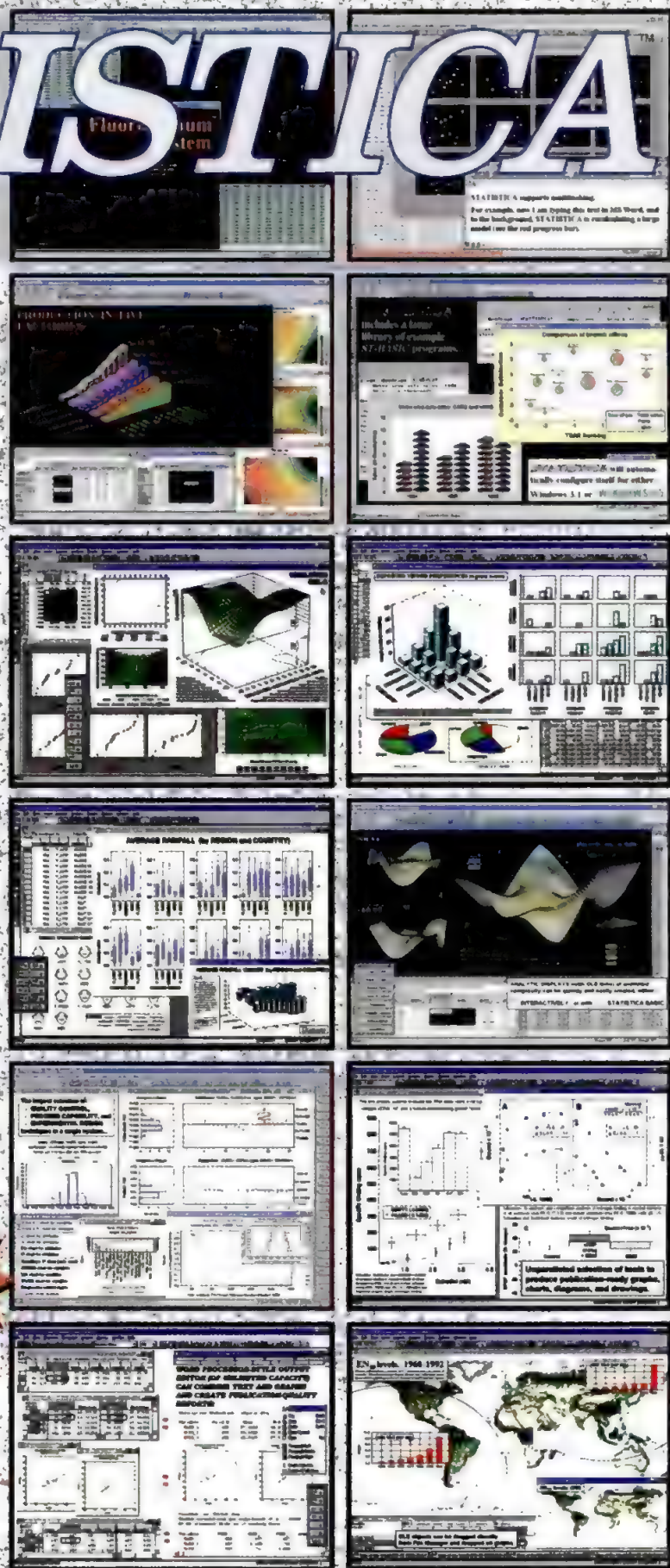
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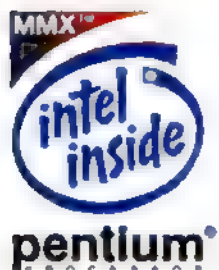
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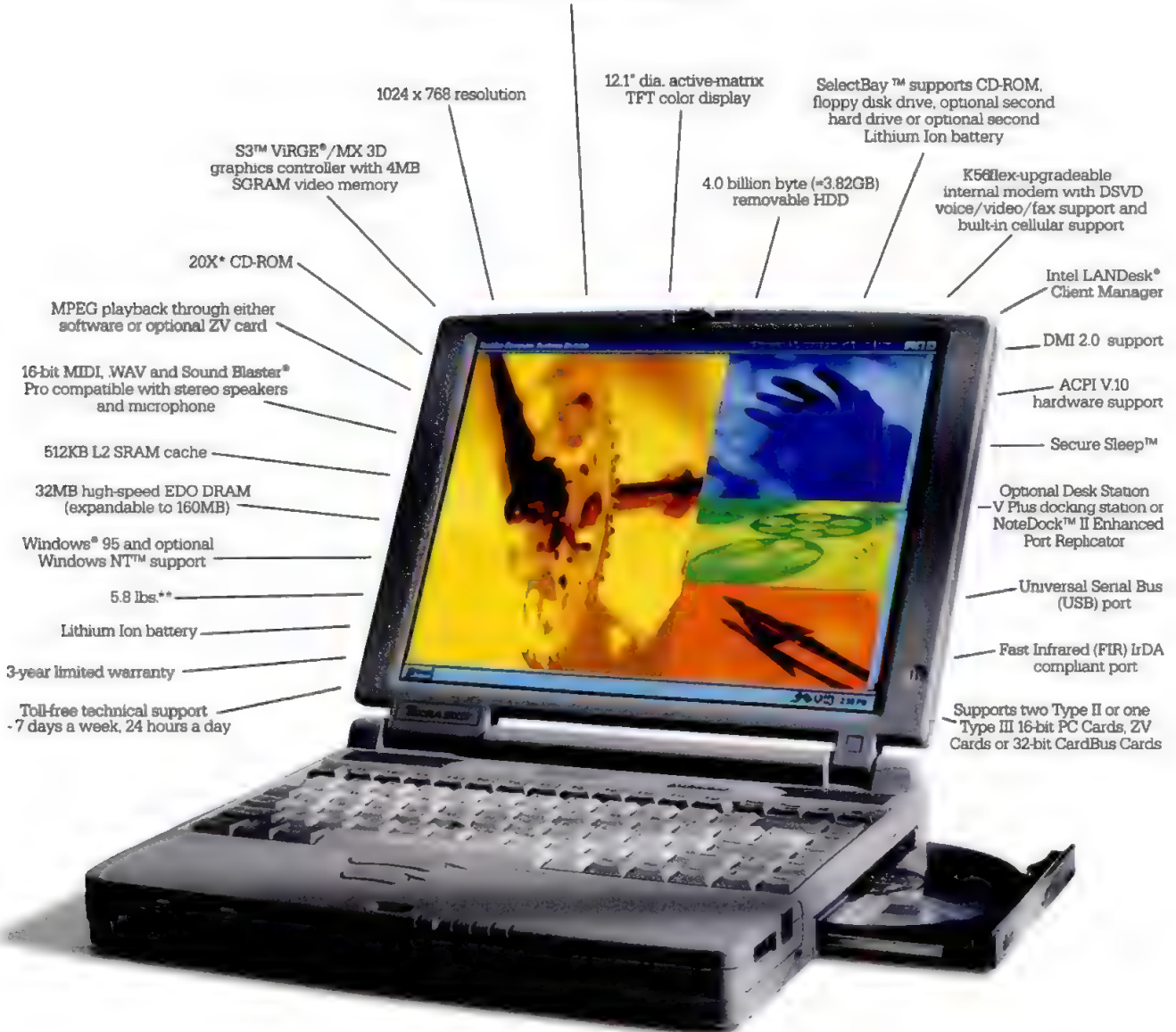
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Trends

Trading Cards

With baseball cards, it's fun.
With credit cards, it's fraud.

The computer industry and credit card companies are continually reinforcing the Internet with an assortment of safeguards to soothe consumers' concern over typing in their credit card numbers and to encourage cybermerchants to set up shop. The efforts are paying off. Market research firm Jupiter Communications estimates that online shopping revenues will soar from \$2.6 billion in 1997 to over \$37.5 billion by 2002. That's still a trickle compared with total retail spending, but it's obvious that plenty of consumers are using their credit cards on the Web without concern.

That's not to say that the Web is free from credit card fraud. Based on informal reports from online merchants, the problem isn't that credit card numbers are more likely to be stolen on the Web than in stores, in restaurants, or over the phone—but that stolen card numbers are being used to make purchases over the Web.

A popular pastime among credit card abusers these days is trading stolen credit card numbers over the Internet. Known as *carders*, hackers who specialize in stolen credit card numbers are a threat not only to legitimate cardholders but also to the online merchants they're ripping off.

People who engage in online credit card fraud fall into either of two profiles, according to John Pettitt, chief technology officer at CyberSource—a developer of software to stymie online scoundrels. Those who do it for sport are generally 14- to 18-year-old males eager to check out pornography sites. Those in the other crowd are professionals, dealing in high-value goods they can easily fence, such as notebook computers and printers.

A ROADHOUSE IN THE BAD PART OF TOWN

Although credit card companies limit their cardholders' responsibility to \$50 in cases of fraud, it's a different story for merchants, who must absorb the losses themselves. (Visa and Mastercard recently changed their policies in



order to protect merchants as well, but only when transactions are processed using Secure Electronic Transactions—or SET—a protocol that's not yet in widespread use.) Take ShellServer, a four-person company started last November to provide accounts and services for Internet Relay Chat users. (Prices range from \$12.95 a month to \$50 a month.) "We've experienced over 95 percent bad or stolen cards. It's devastating our company," says managing director Jeff Bonforte.

Since ShellServer offers software that the carders use—namely IRC client software—it's an especially hard-hit target and an extreme example of credit card fraud on the Internet. "We've opened a roadhouse in a bad part of town," says Bonforte.

He explains that the carders steal credit card numbers by conventional means, such as searching through trash or by stealing mail, and then exchange them using Web sites and IRC chat rooms. If carders steal card numbers in Chicago, for instance, they may use

IRC to trade them with someone in Indiana. They would then set up an e-mail account in the cardholder's name and make purchases over the Web.

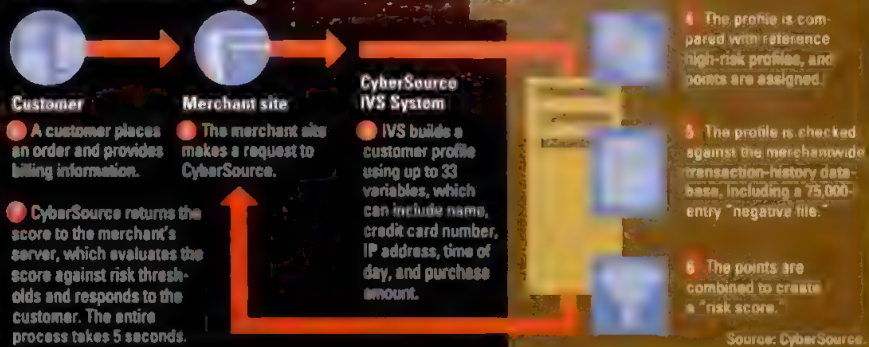
The purchases are usually for digital content such as software or pornography rather than for products that can be traced to a delivery location. "Credit card numbers aren't stolen over the Internet. They're being transferred

over the Internet once they're stolen," Bonforte says. "I'm still much more confident using my credit card on the Web than in a store," he adds.

Software.net, a popular site where you can buy and download software, has experienced similar problems. During one week in early 1995, the site dealt with more fraud than business. That grim fact encouraged John Pettitt of CyberSource, which runs software.net, to develop an antifraud system. He wrestled the incidence of fraud at software.net down to less than 1 percent of its business.

Pettitt saw an opportunity and started selling his homegrown technology, IVS Fraud Screen, to other online merchants. The service runs transactions through more than 100 consistency and validation factors to uncover potential fraud. CyberSource maintains a database of fraud information gathered from all participating merchants. "IVS is an identity-checking system. It doesn't determine whether intentions are honest," he says. —Carol Levin

Online Identity: True or False?





INSIDE PC LABS

ActiveX: Now and Then

Did Microsoft's marketing go overboard?

Lately, Microsoft's ActiveX just hasn't been the buzzword it once was. Several recent news stories have cited the market for ActiveX controls which work with the Component Object Model (COM) as slowing down. That's happened even as the so-called Gang of Four—IBM, Netscape, Oracle, and Sun—have their sights on a new wave of cross-platform Java applications and Version 3.0 of the Common Object Request Broker Architecture (CORBA), a competitor to COM, due at year's end. Microsoft has recently posted a lengthy question-and-answer page on its Web site defending ActiveX and COM.

According to Microsoft, there are over 6,000 ActiveX controls, and it will be over a \$1 billion market in 1999. Microsoft admits, however, that marketing did go a little overboard with ActiveX by casting it as the whole component model. "ActiveX is only a packaging technology for COM objects," according to Microsoft's Q&A on the issue.

Tom Johnston, of Microsoft's Platform Team, stresses that Microsoft foresees many different tools and platforms. "We believe in using the right tool for the right job," he says. Johnston points out that the promised abundance of "write once, run anywhere" Java applications hasn't really materialized, and that many applications built in ActiveX or Java could be done using just Dynamic HTML (DHTML).

CORBA 3, which several companies including IBM, Netscape, Oracle, and Sun are developing, will be based on the JavaBeans object model and will feature improved COM-to-CORBA interoperability and ease of use, according to the Object Management Group. CORBA 3.0 will also include a Portable Object Adapter specification targeted at plug-and-play CORBA beans.

Part of the goal for CORBA 3.0 is to build a market for cross-platform components that rivals the ActiveX component market. But as Microsoft's Q&A states: "Active X controls rely on Win32 features, so they're not on Unix or the Macintosh. ActiveX is designed for power, not ubiquity."—*Sebastian Rupley*

Java Takes On Windows, Sort Of

AFTER TESTING SIX JAVA ENVIRONMENTS for "Java Development Packages" for our issue of April 7, 1998, PC Labs turned its attention to a pressing question: Just how much faster is native code Windows applications compared with Java?

Most people still run Windows and native code, but could it be that Java will one day run most of the world's software? Curious, we set out to develop and conduct tests so we could tell you where Java stands in relation to native code.

After testing, we can only tell you that the jury is still out. As it turns out, comparing Java performance with that of native programs is quite complicated.

Unlike conventional software, Java programs aren't distributed as native executables for a single CPU, such as a Pentium. Rather, they're written to execute on a "virtual computer" that's emulated by software (hence the term Java "virtual machine"). These instructions, called *bytecodes*, are interpreted at runtime into instructions for a specific processor, whether it's a Windows/Intel x86, a Mac Power PC, or on a Unix

Café for Java for Windows, let developers generate Windows/x86 .EXEs using the Java language. So we attempted to compile ZD JMark 2.0, our state-of-the-art Java benchmark test, into native code.

To simplify matters, we identified four of JMark's tests that would run in the compiled application without change. We lost confidence in this approach, however, when we saw that the native version of the tests were actually *slower* than the Java version of Microsoft Internet Explorer 4. IE may be fast, but it's not *that* fast. Further research indicated that the Intel x86 code generated by these tools is somewhat inefficient. It's also possible that Garbage Collection may have interfered with this test.

So we tried another approach. Our second test uses the equivalent code written for both native code (using C++) and Java. This test creates arrays of data elements and goes through a set number of loops, during which the testing algorithm inserts and deletes elements. This is a timed test, so a lower number indicates better performance.

The chart shown here includes the num-

CAN JAVA MATCH UP?

Native Windows code can provide a substantial performance edge over Java code. Here are our scores for three CPU- and memory-intensive tests run as native Windows code and on three of today's hottest Java platforms. Lower scores indicate better performance.

Minutes:seconds	Native Windows*	Internet Explorer 4	Netscape Communicator 4.04	Visual Café
Vector	1:20	4:14	12:13	3:00
List	1:18	4:04	12:13	2:50
Hash/Map	1:42	4:22	13:23	3:08

* Microsoft Foundation Classes.

RISC chip. This approach is the foundation of Java's "write once, run anywhere" philosophy.

Another challenge to conventional tests is Garbage Collection—Java's built-in feature that tracks memory allocated by a program and frees that memory when it's no longer needed. This feature ensures that memory is always reliably cleaned up. But clean-up also presents a problem for measuring the speed of code, because its timing cannot be reliably controlled.

In our first approach to testing, we created a native code version of actual Java source code. Two of today's Java compilers, Asymetrix Supercede and Symantec Visual

bers for 5,000 elements through each array. But the scores of the Java environments didn't match up with those of the JMark scores we got in our comparative testing. This leads us to believe that our second test is very small in memory and not representative of real-world Java code.

Although the results of our first attempt to compare Java performance with native code performance were inconclusive, we will continue to develop a test that can provide the definitive answer to a question that concerns us all. The evolving relationship between Windows/x86 code and Java may indeed become a battle for the future of computing.—*Larry Seltzer*

No to the Net Tax

Clinton supports electronic tax haven.

Calling the Internet "vital to our nation's economic future," President Clinton is opposing new proposals to tax Internet access and new kinds of electronic transactions. Speaking at a recent BancAmerica Conference, Clinton stressed that the Internet should grow unfettered by new taxation. His comments come at a time when market researchers are observing huge growth in electronic commerce.

Several U.S. governors have supported a proposal to levy a single tax for all online transactions, and Clinton may support such a tax in the future. But the President would like to see no sales taxes on Internet transactions for at least a few years.



He did not specify a hard-and-fast time limit, although a House of Representatives bill suggests six years. The bill, proposed by Rep. Chris Cox (R-Calif.) and Sen. Ron Wyden (D-Ore.) would block states from imposing taxes on Internet access and new types of electronic transactions. Importantly, though, it would not stop states from imposing the same taxes on Internet-based sales of goods as they impose on the

same goods sold outside cyberspace.

"There should be no special breaks for the Internet, but we can't allow unfair taxation to weigh it down and stunt the develop-

ment of the most promising new economic opportunity in decades," Clinton said.

A recent Yankee Group study showed that roughly 5.2 million U.S. households shopped on the Internet during September and October 1997, compared with 3 million for the same period in 1996. The same study showed that online consumers bought \$2.74 billion in goods and services in 1997—up \$730 million from the previous year. A recent report from research firm ActivMedia concluded that revenues generated by commercial Web sites will reach \$1 trillion by 2001—undoubtedly a tax base that state officials will have their eyes on.

President Clinton is discouraging that attitude. "How can we further [the Internet's] growth and foster its magnificent freedom without allowing it to be used as a tax haven?" he asked.

A full resolution won't come right away. Clinton has called for a committee of business executives and Treasury Department officials to evaluate the issue.—*Sebastian Rupley*

JAKE KIRCHNER

Computer Donations: Get Behind It

This issue's article on upgrading your aging PC probably has you eyeing at least one old computer in your home you've been thinking about retiring or replacing. Maybe there are still a few years of life left in it, but then again, you may find that you're better off buying a new system. As for the old one, you'd hate to throw it out. After all, you paid real money for it just a few years ago when it was the hottest model you could afford. Surely someone could use it now.

Take your situation, multiply it a hundred or even a thousand times, and you'll know what many companies are experiencing. Too often, organizations end up throwing out their "obsolete" equipment even though there are charitable groups and schools and churches that would be happy to have it. The good news is that there's a growing movement to donate used but serviceable hardware and software, and there are even new tax laws that make this attractive.

Unfortunately, you can't just drive up to your local school or church with a carload of donations. You have to make sure the equipment is in good working condition, that the paperwork required for any donor tax deduction has been completed, and that the recipient organizations need the hardware, are able to use it, and are willing to accept it.

Typically, you should be donating at least 386 or 486 PCs with sufficient memory to run Windows. Monitors and printers can find new homes, too. What follows is a short course in how to help your company free up its inventory of used computers and help some of the many people who need and want used computing equipment.

Get direction. See whether there are charitable groups in your area that are already involved in funneling used computers to



schools, churches, and other tax-exempt organizations. Many cities and states have existing groups that take cast-off equipment and help refurbish it, and they have contacts with people who need the hardware and software. You can find them on the Web or by calling around. If you can't find one in your area, contact those in neighboring cities or states for advice.

Get information. Talk to your organization's IT managers to find out what equipment they need to move out. If the managers hold onto computers until they're

ten years old and broken, you won't have much to offer anyone. On the other hand, there are tax advantages to companies that donate hardware which still has life in it; your employer may be willing to move out some reasonably new equipment. The IT folks may not be junking Pentium-class PCs, but perhaps they're upgrading a department's 15-inch monitors to 17-inch models.

Get permission. Talk to your Human Resources department about setting up a computer donation project. There may be company policies that come into play, and there may be existing employee volunteer committees that can help.

Get involved. Don't try to set up a computer donation project unless you're willing to help run it. If the project is going to work, it should be a benefit, not a hindrance, to your IT department and company.

Get help. Don't try to do this all by yourself. In any organization there are people willing to volunteer a few hours a month for a good cause.

Get cracking. Every year, millions of computers are thrown out or recycled for raw materials. Many of them could be put to good use. Consider it spring cleaning.

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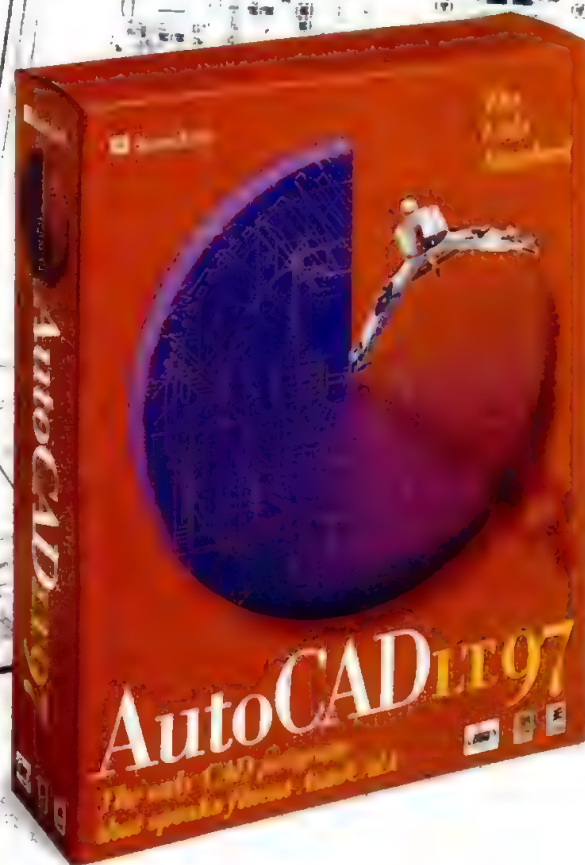
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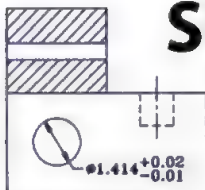
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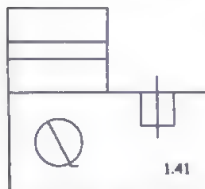
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Although you won't get a Pentium II CPU or high-end graphics at such prices, you will get a solid Pentium-class PC that's powerful enough for most corporate tasks. All systems are network-ready, and some packages include monitors. But most units do not include CD-ROM drives, and some come without network adapters. Given the volatile nature of prices in the PCs market, some of the offerings described here may have gone down in price or been superseded by models with more powerful CPUs at the same price.

Hewlett-Packard (800-322-4772, www.hp.com/go/brio), known for its Vectra line of manageable corporate PCs and its TopTools desktop management software, recently introduced its **Brio** series of low-cost small business systems.

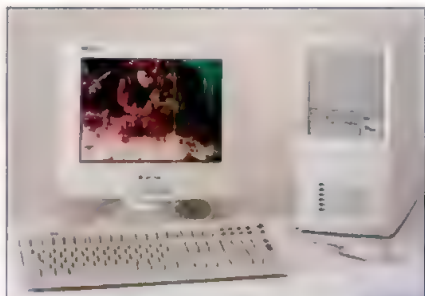
Brio PCs come in three configuration levels: the minimally configured Business level; the Advanced Business level, which adds a CD-ROM drive and a 16-bit audio card; and the Advanced Business Communication level, which adds a 56-Kbps fax modem and remote diagnostics support. All Brio systems come with the Brio Center, a graphical interface that provides quick access to on-line documentation and support.

HP's Brio units have street prices starting at \$850 for the **Model 8211** (a 200-MHz MMX Pentium with 16MB RAM, a 2.1GB hard disk, and no CD-ROM or monitor).

Ever since Monorail Computer Corp. (770-421-1102, www.monorail.com) debuted in 1995,

the company has forged a niche by producing low-cost, all-in-one PCs with LCD monitors. Now Monorail has expanded its scope to offer its **NPC** series of full-size mini-tower corporate PCs. These DMI 2.0-compliant midtowers start with the \$849 **NPC 5000**, a Pentium MMX/200 with 16MB of SDRAM, a 2.1GB hard disk, a 10-Mbps Intel Ethernet card, and no CD-ROM or monitor.

Monorail offers its M-150 15-inch monitor for \$199. The company keeps prices down by not



POWER BARGAINS: Affordable PCs from Hewlett-Packard (above), Monorail Computer Corp. (right), and Gateway 2000 (above right).



warehousing PCs; instead, Monorail ships them to its channels as it builds them.

Gateway 2000 (800-846-4208, www.gateway.com) has also entered the sub-\$1000 business PC market with the low-end of its **E-1000** series of standard and Net PCs. The \$999 Gateway E-1000 166 comes in a slimline case with a Pentium MMX/166 CPU, 32MB of SDRAM, a 2GB hard disk, an integrated 10/100-Mbps Ethernet adapter, an integrated PCI graphics subsystem with 2MB of DRAM, and Intel LAN-Desk Client Manager Software.

Also offering a value line of managed PCs is Dell Computer Corp. (800-388-8542, www.dell.com). When configured without a network card or monitor and equipped with a Logitech mouse instead of Microsoft's IntelliMouse, an **OptiPlex Gx** with a 200-

MHz MMX Pentium CPU, 32MB of SDRAM, and a 2.1GB hard disk costs \$899 (direct). An upgrade to Microsoft Windows NT is available for an additional cost of \$89.

Digital Equipment Corp. (800-344-4825, www.digital.com) offers a very big selection of corporate computing solutions, and it has aggressively pushed the low end of its corporate line by offering complete systems (including monitor) for under \$1,000.

Digital's **3010 Series** corporate PCs use Digital's Unified Memory Architecture, which cuts costs by combining core logic and graphics support in the same chip set.

Earlier this year, Digital offered purchasers of its \$793 **Digi-**

1MB of SGRAM. For \$1,199, the unit can be bundled with a Compaq V50 monitor.

IBM (800-426-3395, www.pc.ibm.com) is offering its

IBM PC 300GL line of Pentium MMX- and Pentium II-based value corporate PCs. A model with a Pentium MMX/200 CPU, a 2.5GB hard disk, and 16MB of SDRAM costs

exactly \$1,000 (street).

There are some alternative options you might want to consider if you're looking for a solid, sub-\$1,000 corporate PC. First is shopping the clearance-sale Web sites operated by some of the PC vendors. For example, Monorail sells discontinued and reconditioned stock of some PCs via its Factory Outlet Web site (outlet.monorail.com). IBM also offers refurbished home and business PCs through the Web (refurbishedpcs.financing.ibm.com).

Another option comes from Recompute Corp. (800-510-8414, www.re-compute.com), a company that specializes in remanufactured PCs for home and business users. The type and brand of systems may vary; nevertheless, for reference, Recompute offered a remanufactured Compaq Deskpro 2000 with a Pentium/133 CPU, 16MB of RAM, a 2.5GB hard disk, an 8X CD-ROM, a 16-bit sound card, speakers, and a three-year warranty for \$779. A 15-inch Recompute monitor had a \$199 price tag and a one-year on-site service upgrade cost \$49.

—Robert S. Anthony

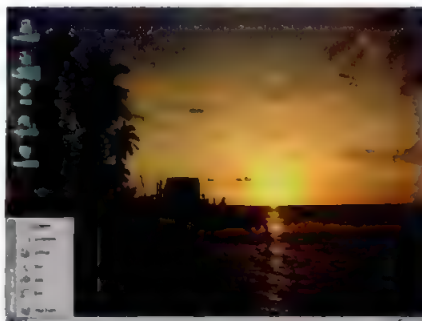
RECAP PC Magazine last reviewed PCs in our issue of December 2, 1997. The Dell Dimension XPS D266 and the NEC Direction SPL266 were awarded the Editors' Choice for Professional/Enthusiast PCs. In the Corporate PCs category, the IBM PC 300PL and the Compaq Deskpro 4000 6266X/3200/CDS were awarded the Editors' Choice.

UTILITIES

Brightening Your Desktop

Do you shudder every time you fire up your computer and see the standard Microsoft Windows 95 desktop pattern and screen saver? Two new products aim to take the stress out of creating a pleasing facade for your work environment.

John Neil & Associates (800-663-2943, www.jna.com) offers **Sundial 2.0**, a unique program that displays time-lapse landscape photography on your computer's desktop (\$19.95; \$6.95 upgrade). Joining the initial Volume I release—which



AS TIME GOES BY: Sundial 2.0.

features QuickTime movies of California landscapes that slowly change over the course of the day—is Volume II, which presents ten soothing scenes of the Hawaiian Islands. An algorithm in the program synchronizes the Sundial desktop to the current time of day, so you can gauge the day's progress by simply glancing at the landscape on the screen. You can also preview all the sequences and choose which one best suits your desktop.

If you've already acquired images you'd like to assemble into a screen saver, turn to the \$24.95 **V.I.P. Screen Saver**, from Rhode Island Soft Systems (800-959-7477, www.risoftsystems.com). This handy utility lets you use photographs and videos as screen savers and wallpaper on your PC. The Portfolio Manager provides a means of adding and managing the files you wish to display. It also shows you which images have been selected and allows you to specify the order and transition effects for those images. You can even control the duration between images and customize frame and matte style. A shareware version is available at the company's Web site.

If you already have several screen savers but have difficulty

choosing which one you'd like to use, how about using them all? **PC Magazine's** shareware utility **Screens: A Screen-Saver Manager** lets you schedule which screen

savers to use on which day of the week or month. Screens is available for download via the Free Utilities section at www.pcmag.com.—Sharon Nash

UTILITIES

Keyboard Controls

Although seemingly long forgotten in the software era of mouse-driven pull-down menus and dialog boxes, your keyboard's function keys can still provide a faster, more powerful way to accomplish tasks. Moreover, shifting some of your action controls to the keyboard helps vary the way you can navigate through Windows.

With the specific intention of personalizing function keys to "put them back to work," **ShortCuts**, from Kiss Software Corp. (714-979-5477, www.kissco.com), is aimed at those who've allowed their function keys to lie dormant. Users of this \$29.95 package can define and perform up to 42 different tasks for 21 keys. These include the 12 function keys, the 6 edit keys, and the shutdown,

One-Stop Shopping

Tired of having a cacophony of utilities to accomplish specific tasks? Take a look at Mijenix's **PowerDesk Utilities 98**, a versatile, all-encompassing package that puts you in control of your desktop (800-645-9643, www.mijenix.com).

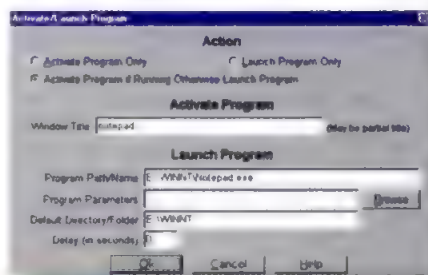
The beauty of PowerDesk Utilities lies in its simplicity. Headlining the powerful array of features is the self-titled PowerDesk file manager. Essentially offering the functionality that Windows 95's Explorer neglected to integrate, PowerDesk builds on the familiar Explorer interface to provide such conveniences as support for zipping and unzipping files, split-screen file viewers to instantly preview files within Explorer, the ability to view multiple drive tree directories within Windows simultaneously, an enhanced file finder, a tool for managing the space on your hard disk, easy conversion between graphics formats, synchronization between folders, file encryption, and a built-in decoder for deciphering Internet e-mail attachments.

Another boon is the PowerDesk quick launch toolbar. This fully customizable floating toolbar gives you single-click access to your favorite programs as well as a simplified means of accessing the Windows Start Menu directories. —Melissa J. Perenson



wintools.com) has released **Keyboard Express 2.5**, the latest upgrade to its Windows keyboard macro utility. Priced at \$24.95, Keyboard Express lets you record, input, and play back any set of keystrokes and associate it with one of over 500 different hot keys. New to this version is the ability to run the software over a network; there's even an optional browse-only mode. Also, you can now size and position the windows of other applications on the desktop. Another new feature is the ability to load in a text file during macro playback to process as part of the macro.

If you're looking for a quick way to replace text, then consider Insight's \$19.95 sister product, **ShortKeys 98**. Whereas in Keyboard Express you assign hot keys to your task, ShortKeys lets you assign a combination of letters—sans control codes—so that every time you type that set of letters, the text will expand correspondingly. This utility is handy for use with word processing, e-mail, and database applications.—SN



HIT THE KEYS: Keyboard Express 2.5.

step guides to selecting types of functions, and an Online Update feature lets users download the latest versions of ShortCuts.

Meanwhile, Insight Software Solutions (801-295-1890, www



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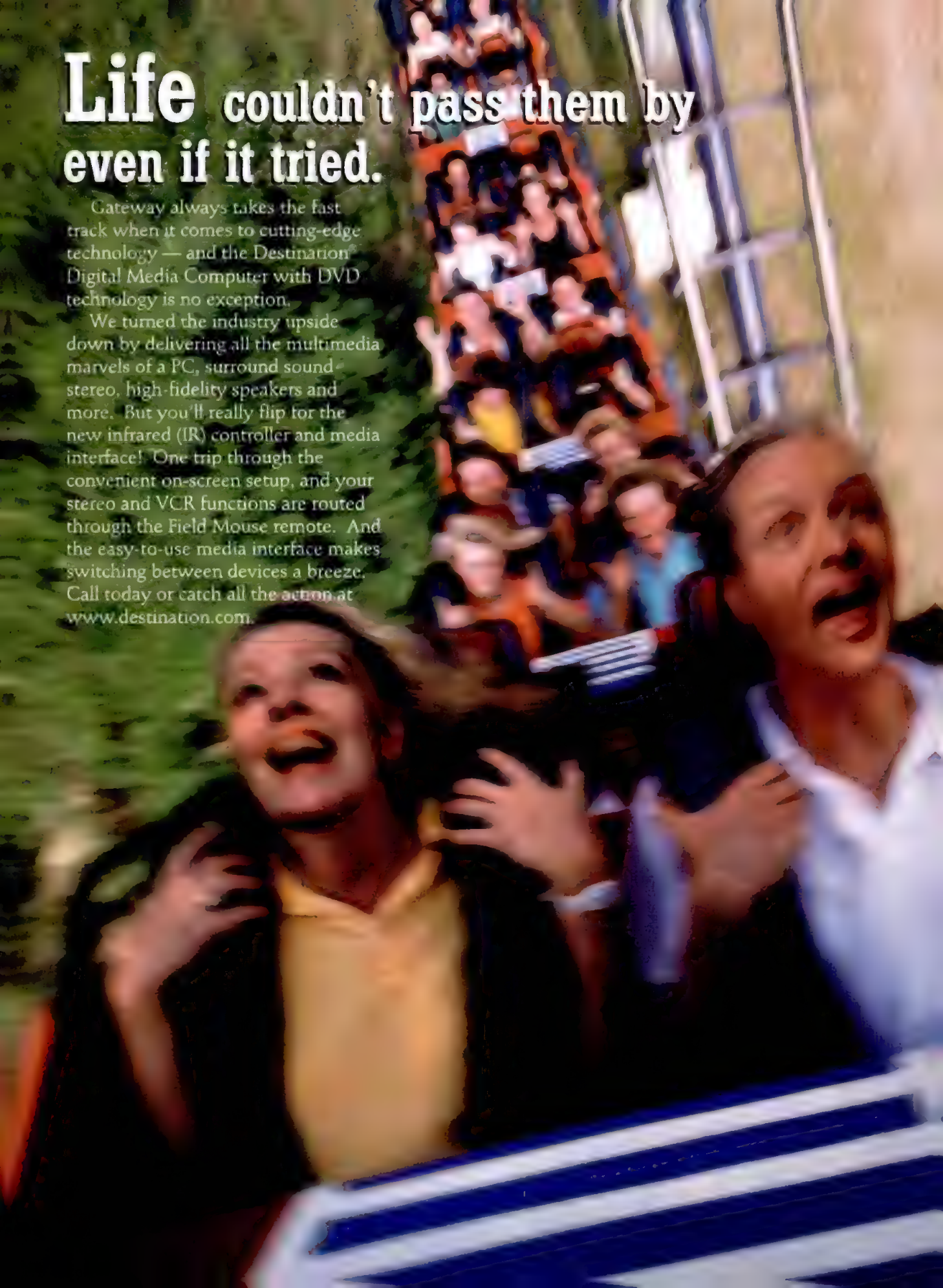
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 *According to a BatteryMark 2.0 battery life benchmark test conducted September, 1997 by Key Labs, Inc. Battery life may vary depending on use. A free copy of the test is available at www.keylabs.com.

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- 3GB Hard Drive
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- 2 USB Ports, CardBus & Zoomed Video Support
- NTSC/PAL Video Output
- Integrated 16-Bit Sound & Stereo Speakers
- PC Card Modem w/ x2 Technology & cellular support
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- NTSC/PAL Video Input & Output
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- PC Card Modem w/ x2 Technology & cellular support
- EZ Pad Pointing Device
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Solo 9100, PC Magazine Editors' Choice Award, January 1998



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- Epson Stylus COLOR 800 Ink Jet Printer **\$349**
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- Hewlett-Packard 890Cse Color Laser Printer **\$399**
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Trends Peripherals

PRINTERS

Printer Prices Fall, Again

The cost of high-quality personal ink jet and laser printers continues to drop, giving users new choices for printing professional-looking documents both quickly and easily. Several vendors have unveiled new models that combine high resolutions and faster print speeds.

Lexmark International (800-539-6275, www.lexmark.com) adds to its line the **5700 Color Jet-printer**, a 1,200- by 1,200-dpi ink jet device. Priced at \$250 (street), the printer runs at a quiet 47 dB and has a rated speed of 8 pages per minute (ppm) in mono-

chrome and 4 ppm in color. It also includes the Accu-Feed paper-handling system, which is a standard feature of the company's Optra line of laser printers. According to Lexmark, the Accu-Feed system reduces paper jams by increasing sensitivity to media weight and by eliminating paper bucklers that can cause wrinkling.

For home and small-business users, Mita Copystar America (973-882-4483, www.mita.com) offers its **DP-580** (\$350 street), a 6-ppm monochrome laser printer with 1,200-dpi resolution. This lightweight, small-footprint device comes bundled with 2MB of memory (expandable to 18MB) and includes a 100-sheet top-loading paper cassette with a straight path for avoiding jams;

output collects face down for automatic collating. Notably, the DP-580 includes a positive charge on its imaging drum to eliminate ozone emissions.



If you're interested in printing images taken with a digital camera, consider the **PV-PD2000** digital photo printer (\$599.95 list), from Panasonic Consumer Electronics Co. (800-211-7262, www.panasonic.com). This thermal-dye unit is equipped with a PCMCIA slot, which allows direct printing from your camera's flash memory card. The PV-PD2000 has a 144- by 288-dpi maximum resolution, and it pro-



AFFORDABLE VIRTUOSOS: Printers from (top to bottom) Mita, Panasonic, and Lexmark.



duces images with a full 16.7 million colors. It can also work with virtually any video source, including camcorders, VCRs, DVD players, and TVs.—*Josh Levy*

RECAP We reviewed 37 personal ink jet and laser printers in our issue of November 4, 1997. We gave our Editors' Choice to units from Epson, HP, and NEC.

PRESENTATION MONITORS

Big, Bold Displays

If you're looking for a high-quality, large-format monitor to present PC data more effectively in a boardroom or training room, then have a look at these latest presentation displays from major players in the market.

Fujitsu Microelectronics (800-866-8608, www.fujitsumicro.com) upgrades its ImageSite line of plas-

ma monitors with the \$10,999 **ImageSite 42**. With twice the brightness and nearly six times the contrast of the previous model, this 42-inch plasma display has a fixed internal resolu-



MAKING A SPLASH: Dazzling screens from Princeton (above) and Fujitsu (below right).

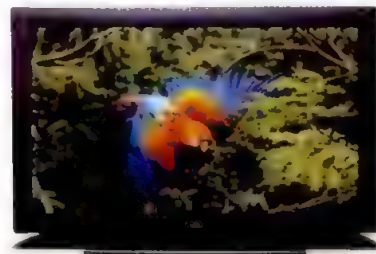
tion of 852-by-480 pixels—perfect for DVD and HDTV. The viewing angle is a wide 160 degrees, both horizontally and vertically. The flat-screen nature of this plasma monitor makes it ideal for wall mounting.

From the Panasonic Broadcast & Digital Co. (800-524-0864, www.panasonic.com/PBDS) comes the \$3,200 **CT-3696VY**, a 36-

inch color multiscan CRT monitor and receiver. The monitor delivers 800-by-600 resolution and incorporates an automatic scanning function that self-adjusts to horizontal frequencies from 15 to 38 kHz. Audio functions include stereo sound with dbx noise reduction, two 7-watt stereo speakers, bass and treble controls, and variable audio output jacks. An integrated artificial-intelligence sound function auto-

matically keeps sound at a constant level, regardless of swells in volume from the input source.

With a 31-inch viewable area, the \$1,399 **Arcadia AR3.1AV**, from Princeton Graphic Systems (800-747-6249, www.prgr.com), is targeted at both business and home PC/TV buyers. It features video output in 24-bit true color and edge-to-edge sharpness in text and graphics modes. The maximum resolution is 800-by-600 at 60 Hz, but it's capable of 640-by-480 at 75 Hz. When attached to a computer's NTSC



port, it offers scalable picture-in-picture capability and can be paired up with a Web TV console. Princeton also offers a 27-inch model, the **AR2.7AV**, for \$999.—*Roderick A. Beltran*

RAID for the Rest of Us

When a hard disk malfunctions in an important office PC, it can bring operations to a halt and cost thousands of dollars in lost revenue. But until now, giving your data the protection it needs has meant either constant backup operations or investing in a SCSI-interface hard disk and RAID controller.

Thankfully, there's a new solution available. The **DupliDisk-PCI**, from ARCO Computer Products (954-925-2688, www.arcoide.com), is a \$225 RAID mirroring adapter for IDE devices. Just plug it into a PCI slot, connect it to two hard disks (one via the primary cable, the other via the mirror cable), and load the software.

The result: Your computer will write the same data to both disks simultaneously. Though this will usually slow down your machine by up to 50%, it's a small price to pay for the peace of mind that comes from protecting mission-critical data in a secure and redundant format.—*JL*



Crash.



Boom.



Bang.



Click.

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PartitionMagic®*

Your hard drive blew up. You lost your tax spreadsheets. Your addresses. That critical business proposal. Not to mention your sanity. You had your whole life contained in a few gigs. Which is why it's a good thing you used Drive Image™ from PowerQuest®. In minutes, you were able to make a complete backup of your hard drive on a Zip®, JAZ®, or almost any other removable media. When disaster struck, you simply reloaded the copy of your hard drive and you were back in business. No hassles. No missing

preferences, partitions or passwords. No problems. Just a click of a button and your computer was restored to its exact state before the crash. It's that simple.

And what's more, Drive Image is also:

Easy—A user-friendly interface makes it easy to manage your saved files. And a step-by-step wizard simplifies the backup process.

Fast—Drive Image can now create a compressed image of your hard drive up to five times faster than before. Plus, with its patent-pending SmartSector™ technology, Drive Image can copy significantly faster than traditional backup methods.

Safe—Drive Image now features ImageShield™ password protection and encryption to protect critical information. It also automatically checks disk integrity and looks for bad sectors to prevent data loss from occurring.

Flexible—You can quickly restore your whole hard drive or recover individually selected files. Drive Image also allows you to “span” across removable media, such as Zip®, JAZ®, and SyQuest® drives.

Now, restoring your hard drive is as easy as blowing it up.

For more information about Drive Image, or to learn about additional licensing options, call 1-800-379-2566.

Get \$15 cash back from PowerQuest.

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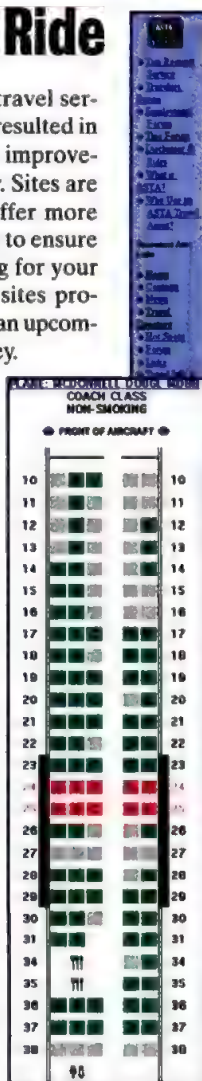
Ticket to Ride

Competition among travel services on the Web has resulted in constant changes and improvements to the category. Sites are more user-friendly, offer more information, and help to ensure you get the most bang for your buck. The following sites provide new ways to plan an upcoming trip and save money.

Bolstering its service through the addition of several new trip-planning features is The Sabre Group's **Travelocity** (www.travelocity.com). Detailed overviews of virtually every country and U.S. state have been added to the Destinations & Interest section of the site, including discussions on when to go, travel tips, and transportation details. In addition, Travelocity has teamed up with ZD Comdex and Forums to offer online access to published airfare prices and special negotiated rates on United Airlines. Travelocity plans on offering this service for other upcoming shows and conferences.

Also new to the site is the inclusion of airplane seating maps. These maps enable you to see and select your seat when booking most flights on Delta Airlines, American Airlines, and United Airlines. A color-coded map of the plane identifies which seats are available, and it even displays exit-row seats, seats for the disabled, and wing location. You just enter the row and seat letter you want in a "desired seat" field and your selection is confirmed (as long as it's available).

Do you ever wonder why a full flight sometimes has empty



Tips Forum

Messages posted here **MUST** be related to this forum or they will be deleted by the ASTANet System Operator. Messages will be automatically deleted after 30 days.

There are 5 resources posted

● Subject: RP Online travel reservation system
From: antaryop@antinet.com
Date: 18-FEB-1998

● Subject: Online travel reservation problem
From: Justin White@hotmial.com
Date: 12-FEB-1998

• Subject: 20/20 Cruis Airline Force/Travel Agents
Good!
From: Nikki_Beare@prodigy.com
Date: 20-JAN-1998

TRAVEL AIDS:

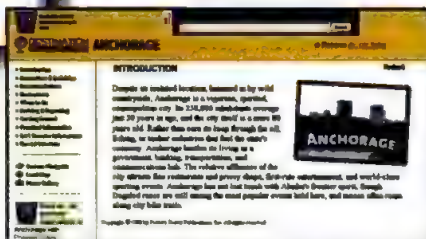
(clockwise from left to right) Travelocity, ASTA, and Preview Travel.

seats? **priceline.com** (www.priceline.com) offers those seats to consumers at prices they name. Via the Web site, users can make free requests (six months to two days in advance, with a limit of one per trip) for their destination and travel dates and requested prices. Users must travel on one of the eight major participating airlines (which cannot be individually selected) and fly be-

tween 6 A.M and 9 P.M., priceline.com's tickets are round-trip coach tickets between two cities; other restrictions apply, including no frequent-flyer miles. You'll receive confirmation or denial within one hour via e-mail or by calling priceline.com's toll-free number. Tickets are sent as e-tickets or (for a \$10 fee) via Federal Express or United Postal Service Express Mail.

Recently added to the **Preview Travel** site (www.previewtravel.com) are Destination Guides, which feature in-depth travel-planning information for more than 70 cities worldwide. This content, from Fodor's Travel

Guides, includes travel tips and information on attractions, hotels, and restaurants. The destination information is integrated into the reservations network. Travel-planning tools include a hotel finder, a restaurant finder, and custom mini-guides that let you build your own travel guide tailored to your tastes. The hotel finder lets you search by name, price, amenities, and general location or neighborhood.



The restaurant finder searches by location, name, price, and type of cuisine.

The American Society of Travel Agents' (ASTA) Web site,

RECAP *PC Magazine*
reviewed 15 travel
Web sites in the issue of January 6,
1998. An Editors' Choice was
awarded to Biztravel.com.

ASAnet (www.astanet.com), now includes hundreds of new pages designed to answer common travel questions and serve as an online gathering place for consumers seeking and sharing travel information. ASTA's Travel Directory offers an index of all ASTA member travel agents grouped by location and specialization. The site can help you find

an agent or tour operator in good standing with ASTA.

A new section on the site called "Share Your Travel Experiences" lets you communicate with other travelers about travel destinations and at-

tractions. The Travel Tips forum offers counseling from travel professionals on all aspects of travel planning.—*Jennifer Anderson, Doug Beizer, and Trevor Dawes*

UTILITIES

Multiply Your Options

The Internet may offer a multitude of fun and informative sites, but as any frustrated Web surfer knows, it's nearly impossible to toggle between two related pages at once. You can open multiple browser windows or press the Back button, but that's about it.

VivaTexte (819-778-7358, www.vivatexte.com) addresses this issue with the **Multipage Browser**, a new solution that may help you make better use of the Web. The Multipage Browser enables you to open up to nine Web sites or HTML pages at once and access them by using a tabbed interface. Developed with Microsoft Internet Explorer technology (but also compatible with Netscape Navigator), the Multipage browser

may be used for both Internet and intranet applications. The browser can be used and customized on individual workstations or saved on a network file.



TAB AROUND: With the Multipage Browser, from VivaTexte, you can toggle between several Web pages at once.

Developers can even launch it for page scripting.

The desktop version of the browser (Version 4.1) costs \$19.95—*Stephanie Lindenbaum*

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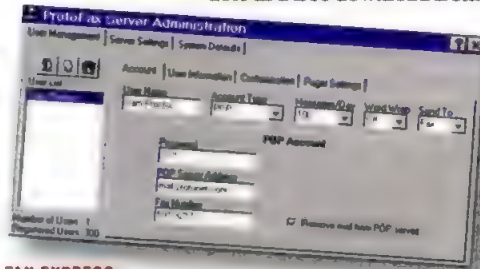
Faxing over the Internet is growing in popularity, so it's no surprise that three more companies are offering Internet fax services. Solutions from CyNet (800-964-2963, www.cynet-fax.com), Intergram International (800-595-8977, www.intergram.com), and ProtoNet (800-551-0636, www.protonet.com) can help save you money by letting you use your Internet connection to send digital-quality paperless faxes.

The **CyNet HyperLine Fax Connection** lets users send Internet faxes from fax machines, fax servers, or fax modems. HyperLine works in conjunction with CyNet's Global Fax Service, which is a proprietary network of computers, and can be accessed with CyNet's free dialer box or free Microsoft Windows-based

software. The dialer box sends a document from the fax machine or modem to any one of the 32 U.S. "CyNet Cities" for 11 cents a minute and any "Off-Net City" for 14 cents a minute. When the service is

used in conjunction with the software (which you can download off the Internet), the cost drops to only 5 cents a minute when faxing to a CyNet City and 9 cents a minute when faxing to an Off-Net City. International pricing for both options is based on varying rates per country (for instance, 40 cents a minute to Mexico and 10 cents a

minute to the United Kingdom). Intergram is taking a different approach. **IntergramFaxIt!**, available as a free download from



FAX EXPRESS:

ProtoFax lets you fax any Windows document across the Net.

the company's Web site, uses the Internet to connect desktops with Intergram's global network for out-bound fax delivery. Users can send faxes from common desktop applications, including Microsoft Excel, PowerPoint, and Word. Documents travel via the Internet and over Intergram's network. Pricing is based on a per-page basis and applies only to successfully delivered faxes. Each page transmitted in the U.S. costs 12

cents a page, while various rates apply to international faxes (it costs 32 cents a page to fax to France and Germany and 33 cents a page to fax to Japan). Both individual and multiple user accounts are available.

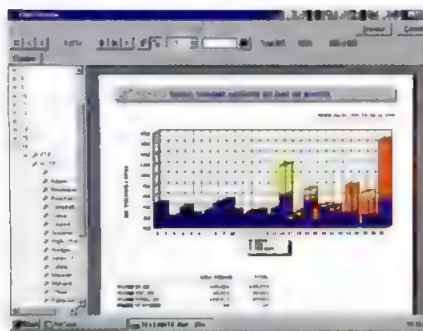
From ProtoNet comes **ProtoFax**, an Internet gateway that delivers documents from the Internet to fax machines and alphanumeric pagers via e-mail, the Web, and Windows applications. Designed specifically for ISPs and private networks looking to add faxing capabilities, ProtoFax runs on Windows 95 and NT and can be connected to an existing network via an Ethernet connection. Once connected, clients can access the server from any platform. ProtoNet's free print driver makes it possible to send any Windows document over the Internet to another ProtoFax server. Pricing starts at \$249 for ProtoFax Server 3.0 for 300 users and one fax port.—Emily Cohen

IP MONITORING TOOLS

Getting a Handle on IP

Getting your corporate network connected to the Internet is now a fact of life. But keeping track of your network is constantly be-

Geared toward ISPs and large networks, Micromuse's **NetCool/Internet Service Monitors** provide a suite of seven monitors that allow you to manage your DNS, FTP, HTTP, NNTP, POP3, RADIUS, and SMTP services. NetCool/Internet Service Monitors collect alarms, faults, and warning messages. Using data from 50 additional prebuilt probes that gather information from SNMP, MIBS, and non-SNMP environments, NetCool stores the data in ObjectServer, Micromuse's repository database, for later retrieval and analysis. Initially, NetCool will work in conjunction with Micromuse's NetCool/Omnibus management application (pricing starts at \$60,000); you can purchase either the entire NetCool suite for \$20,000 or individual components at \$7,000 apiece.



EASY READING: Telemate.Net converts your firewall's TCP/IP logs into simple-to-read logs and notes.

coming more complex. Two vendors, Micromuse (415-538-9090, www.micromuse.com) and Telemate Software (770-936-3700, www.telemate.net), offer solutions that will let you keep an eye on your network's IP usage.

The EventLists screen provides reports based on the ObjectServer data. You can view reports in either a spreadsheet format or in a color-coded graphical presentation.

Telemate Software will soon release the latest version of **Telemate.Net**, its Internet monitoring and reporting tool. Aimed at IS managers and CIOs, Telemate.Net lets you convert the TCP/IP

logs of HTTP, FTP, Telnet, and SMTP from your firewall or proxy server into customizable text, graphical, and HTML-based reports. Telemate.Net currently works with CheckPoint's Firewall-1, Raptor's Eagle Firewall, Trusted Information System's Gauntlet, ANS Interlock, Microsoft Proxy Server 2.0, Netscape Proxy Server, Cisco PIX Firewall, and IBM Firewall.—Robert Daly

Adding Storage is a Snap!

Well known for its CD-ROM servers, Meridian Data (888-343-7627, www.snapserver.com) has branched out into the storage server market with its new **Snap! Server**. Starting at \$100 (street), the Snap! Server provides a simple and inexpensive way to add from 4GB to 12GB of storage to your network without the expense of adding a new file server or the downtime associated with upgrading an existing file server.



The Snap! Server works independently of any existing file servers and does not require you to load any software on your clients or servers. A single, auto-sensing 10/100 Ethernet port connects the Snap! Server to your network. It also supports all major operating systems, network operating systems, and protocols concurrently.—RD

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PC manufacturers typically ship hard disks formatted with one large partition. You know it as the C: drive. Without repartitioning, that drive uses large, inefficient storage units or clusters to store your data. The result is that up to 40% of your hard disk's capacity can be totally wasted. PartitionMagic lets you solve that problem by dividing your hard disk into smaller, more efficient and better organized partitions. Up to hundreds of megabytes of wasted disk space can be reclaimed quickly and easily. It's a no-brainer. For more information, visit our web site at: **www.partition.com.**

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Hiawatha Bray, Boston Globe

"PartitionMagic ... not only gives you more space for data, but lets you manage your data better." *Jim Sundeem, PC Today*



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*Monitor shown with optional USB hub. (\$130 ESP)



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First Looks



USB Device Preview

We take an early look at ten of the first PC peripherals to use the Universal Serial Bus. Full USB support is on the horizon with the release of Microsoft Windows 98.

By Daniel Grotta & Sally Wiener Grotta

The age of the Universal Serial Bus (USB) is coming—and soon. Already, virtually all new PCs and laptops are equipped with USB ports, and Windows 95 OSR/2 provides limited USB support. And by the time Windows 98 (which will offer extensive built-in USB support) ships, we'll see the first onslaught of a wide variety of USB peripherals.

In practical terms, this means that eventually all of your low-speed peripherals could very well be USB devices. These peripherals include keyboards, mice, printers, joysticks, modems, scanners, digital cameras, speakers, and even telephones and fingerprint ID systems.

On paper, USB offers several unassailable advantages over parallel and serial devices. USB peripherals are designed from day one as true Windows Plug and Play devices. There are no boards to install and no jumpers, dip switches, or IRQs to set. Better still, all USB devices are hot swappable and can be recognized and initialized without forcing you to reboot your computer.

USB data transfers have both isochronous and asynchronous throughput of up to 12 Mbps; that's 3 to 5 times faster than parallel devices and more than 20 to 40 times faster than serial ports. The cables can be up to 5 meters in length, and the connectors are slim and compact. Best of all, you can use USB to attach up to 127 devices to the

root hub without worrying about IRQs.

All this may be true, but after testing ten of the first USB products on or about to hit the market, we found that USB—at least at the present stage of development—isn't always easy or trouble-free to install and operate.

CAVEAT EMPTOR

The first surprise we encountered was that early USB iterations may not even work at all. Before the USB Consortium agreed on standards last year, many motherboard manufacturers jumped the gun and added their own versions of USB ports. The USB Consortium does not guarantee compatibility or compliance by nonmember motherboard manufacturers. Be cau-

INSIDE

TRAVEL LIGHTLY:

Toshiba's Portégé 320CT takes some of the weight off your lap without sacrificing power. For the full story, see page 56.



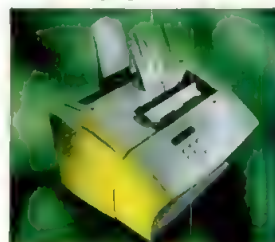
IDENTIFY YOURSELF:

The future is here with voice, face, and fingerprint recognition software and devices. Turn to page 60 for the review.



LASERJET PLUS:

HP's LaserJet 3100 lets you print like a LaserJet 6L and scan, copy, and fax as well. See page 76.



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First Looks Online

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First Looks

tioned, though, that most of these boards will not work with today's USB products.

Another widespread glitch is that many computer manufacturers routinely ship PCs with USB turned off in the BIOSes. But once you know where to look, it's easy to toggle USB on.

Then there's the matter of power. Normally, the USB port outputs up to 500 milliamps (mA) of downstream power. That's more than enough juice to power a keyboard, mouse, joystick, or sheet-fed scanner. But it may not be enough electricity for multiple low-powered peripherals, and it's certainly not enough for devices with higher power requirements, such as printers or speakers. This is why powered hubs will become such important accessories.

Theoretically, it's possible to add up to 127 individual devices between the two ports. But for technical reasons, it's not practical for a single hub to have more than eight ports per hub or for hubs to be stacked more than five deep. If you were to daisy-chain five hubs together, you would cut the number of attached USB devices to 36 per port.

Although there are scores of products waiting in the wings, most manufacturers have delayed introducing USB peripherals until Windows 98 is officially released. At present, Windows 95 OSR/2 Rev B USB drivers support only certain peripherals. You'll need Windows 98 Beta 3 to operate the other products unsupported. Because the drivers are still being tweaked, you may have to set various parameters manually in order to get things working properly.

One final note: USB is only half of the high-speed plug-and-play revolution coming to a computer near you. 1394

(FireWire) is poised to replace IDE, EIDE, and even (in some instances) SCSI. Like USB, 1394 devices are hot swappable and will eventually be able to transfer data at speeds up to 50 MBps. Together, USB and 1394 should make your computer both easier and faster to use.

Central Data Corp.

Central Data USB-40 Port Server

The problem of deciding what to do with non-USB legacy peripherals—such as pointing devices, joysticks, modems, and digital cameras—will probably exist for several years. The USB-40 Port Server (\$400 street) is one of several Central Data converters that allows users to attach non-USB devices to USB ports. Although it works flawlessly and transparently, don't expect plug-and-play action.

95 OSR/2.1 (the company also plans to release drivers for Windows NT 5.0). You can tell it's active when a green ready light on the front of the box is illuminated.

Serial peripherals may be installed or hot swapped at any time. Supposedly, any serial device you plug into the USB-40 Port Server should be automatically recognized by Windows, which will then either install or request the driver. Although we attached several mice, a digital camera, a videoconferencing camera, and a modem, none were automatically recognized. Nor were any devices recognized by using Windows Add Hardware search; instead, we had to install each device manually. Central Data says it will have a fix for this available on request.

Once installed and initialized, the serial devices worked per-

fectly. Although they are accessed through the USB port, the PC sees them as hard allocated COM5 through COM8.

users take note: The USB-41 model (\$500 street) has two RS-232 and two RS-422 ports for attaching Apple or long-distance RS-422 peripherals.

We did have two minor quibbles with the USB-40. First of all, it can't be daisy-chained with other USB devices or hubs (Central Data does plan to release another model that offers this). The other issue is price: At \$400, it's an expensive disincentive to keep most legacy products; you may as well upgrade them or start over from scratch if you really want a USB.

Computer Access Technology Corp.

CATC Andromeda USB Hub

The Andromeda USB Hub (\$100 street), from Computer Access Technology Corp., is for those who don't plan on buying new hubbed monitors but want additional USB ports. Just attach this device to one of your computer's USB ports and you'll instantly have four USB ports.

There's one catch, though: The Andromeda is not externally powered, so many USB peripherals may not even work with it. The Andromeda presently works under Windows 95 OSR/2.1 and Windows 98 Beta 3.

The hub itself is about the size and shape of a pack of cigarettes, and it attaches to your computer via an included 3-foot cable. A flashing green light at the front of the hub lets you know when the Andromeda is working. Peripherals are plugged into the front, which is convenient considering the shortness of the cable. Once the hub is recognized, all you have to do is plug in any USB peripheral and you're off.

Because the hub does not have its own power source, it cannot work with any device that draws more than 100 mA



The paperback-size USB-40 Port Server is a plastic hub with a USB port at one end and four standard DB-9 serial connectors, two mounted on each side. As with all other USB devices, the Port Server does not require individual IRQs for any of the peripherals attached to it. This can be a very important advantage for users with multiple modems or environmental monitoring devices.

Setting up the USB-40 Port Server requires a driver from Central Data Corp. Presently, the driver works with Windows

perfectly. Although they are accessed through the USB port, the PC sees them as hard allocated COM5 through COM8.

The USB-40 inputs 200 mA in the active mode from the USB port. With 100 mA in the power-up mode, the unit provides enough electricity to send a signal to four serial devices at a distance of up to 50 feet each. It supports serial data rates up to 230K baud. The unit ships with a 6-foot cord, although there's no reason why a user couldn't extend that distance to 16 feet for maximum flexibility. Mac

Kodak DVC323
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Connectix QuickCam VC
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of electricity. For this reason, it could not recognize the Storm scanner, U.S. Robotics modem, or Kodak videoconferencing camera we tried to attach. Nevertheless, it had no difficulty handling the NMB keyboard that we looked at in this roundup.

The Andromeda is maintenance-free—just plug it in and forget about it. But with a hub requiring input of 500 mA, there's no provision for daisy-chaining the hub with other USB devices or hubs.

Connectix Corp.

Connectix QuickCam VC

Unlike the Connectix QuickCam 2 (its best-selling predecessor), the Connectix QuickCam VC camera with USB interface (\$100 street) is geared primarily for videoconferencing, not still-image capture. Even so, it can capture 24-bit still images at up to 640-by-480 resolution.

The camera itself is a golf-ball-size black sphere with an f2.0 3.6-mm lens that can be manually focused from one inch to infinity. Except for macros, the depth of field is so great that everything will be sharp, so you'll probably focus it only once and forget about it. The field of coverage is a scant 46 degrees, despite its short focal length. That's about the equivalent of a 65-mm semi-portrait lens on a 35-mm camera. The camera attaches to the computer via a 6-foot cable. Because the cable is stiff (and

awkwardly attached behind the lens), we had trouble positioning and maneuvering the camera on its detached triangular base.

There is no microphone or



QUICK TAKE: Easy installation and terrific software help make the Connectix QuickCam VC a winner.

software all help to make the Connectix QuickCam VC a winning product.

speaker built into the QuickCam VC. Nevertheless, the software automatically interacts with a SoundBlaster-compatible audio card and any microphone and computer speakers.

The QuickCam VC was the only USB product we tested that worked perfectly with both Windows 95 and 98 beta. Install the software from the enclosed CD-ROM, plug in the camera, click on the QuickCam VC icon and within seconds you'll see on-screen whatever the camera is pointed at. The camera automatically adjusts brightness, although there is a slider on the side for setting it manually. Clicking on the appropriate icon changes from still capture to motion.

Although the camera is still

not capable of real-time, full-motion video (30 frames per second), the QuickCam VC's bandwidth produces a maximum frame rate exceeding 15 fps at a CIF (Common Interchange Format) resolution of 352-by-288. This is just

323's frame rate is twice that of the DVC300, and it can now record full-motion video (30 fps) in 24-bit color at a CIF resolution of 352-by-288.

This sleek, compact camera can be operated either directly from the computer or by pressing the silver shutter button on top. The f2.5 6.2-mm plastic lens can be manually focused from infinity to 5 inches by simply rotating a wheel on top of the camera.

Although the optical focal length is fixed, you may instantly activate the camera's electronic zoom feature to switch among telephoto, normal, and wide-angle views. But at minimum (wide-angle) zoom, the field of coverage is only 42 degrees, which corresponds to about an 85-mm portrait lens on a 35-mm camera. Also, shooting wide angle will limit the frame rate to a maximum of 28 fps.

The Kodak DVC323 can easily be detached from the swivel base, and the 10-foot cord tethered between the camera and computer allows users to handhold and shoot as if it were a regular still camera or camcorder. Sighting must be done by looking at the monitor, since the camera does not have an optical or LCD viewfinder. There's no built-in audio, but the DVC323 interacts with any 16-bit sound card and external microphone.

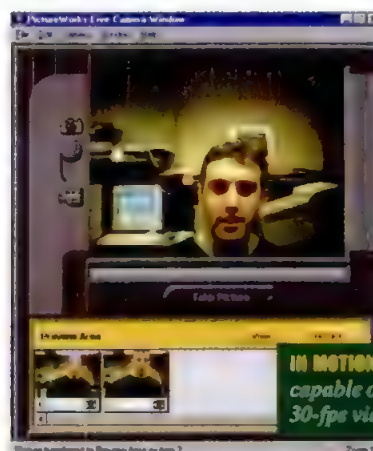
The software that we tested with the DVC323 was beta and worked only with Windows 95, although the shipping version will have drivers for Windows 98 and NT 5.0. Bundled software titles include PictureWorks Live, MS Net-Meeting, and a Twain-compliant driver.

With a power con-

Eastman Kodak Company

Kodak DVC323

The Kodak DVC323 videoconferencing camera (\$169 list) improves upon the earlier Kodak DVC300. The Kodak DVC-



IN MOTION: The Kodak DVC323 is capable of recording full-motion 30-fps video in 24-bit color.

First Looks

sumption of 500 mA, the DVC323 must either be plugged directly into the computer's USB port or a powered hub. Windows recognized and initialized the camera almost immediately.

In most cases, the camera's automatic white balance and exposure allows it to be operated successfully in the default mode. There are also a variety of manual color and video adjustments that you are able to set. The Kodak DVC323's progressive-scan

CCD produces crisp stills and good quality videos, but it needs a great deal of illumination. What's more, the automatic white balance and exposure does not respond well to mixed lighting (such as fluorescent and daylight).

The Kodak DVC323 is an excellent device for capturing still images, and its USB interface aids in creating a data stream that allows real-time, full-motion video.

NMB Technologies **NMB RT-2400W**

What sets the compact, otherwise ordinary NMB RT-2400W (\$40 street) apart from other keyboards is that it will be one of the first USB keyboards on the market; Microsoft Corp. and Keytronic Corp. will both offer USB keyboards as well. The keyboard also takes a page from the Mac's playbook by having a port on the rear for connecting a PS/2 mouse directly to the keyboard. The shipping version of the keyboard will also include a USB pass-through port.

Installing the NMB keyboard is as simple as plugging it in. Windows 98 Beta 3 (the shipping version will work with drivers for DOS and Windows 98, 95, and 3.x) easily finds the

driver and installs it. But unlike the other USB products in this roundup, the NMB required us to reboot the computer before the keyboard and mouse became active. Once we got them to work, we found we could ef-



fortlessly switch between our USB and PS/2 keyboards (as well as our primary and keyboard-attached mice).

Problems occur when you're not running under Windows, such as when you boot directly into DOS. Without the Windows USB driver, the keyboard and attached mouse are dead in the water. NMB says that the production model will be able to run under DOS and Windows 3.x and 95.

In Windows, the keyboard and mouse performed exactly like a standard PS/2 keyboard and mouse. We were able to operate both from any of the hubs, powered and otherwise. Everything works fine—as long as you stay in Windows.



Philips Consumer Electronics **Philips USB Digital Multimedia Speakers**

Also new from Philips is the USB Digital Multimedia Speakers DSS350 (\$200 street price), among the first all-digital computer speakers on the market. With 15 watts of RMS power per channel per speaker (plus an additional 60 watts total with the

optional \$50 subwoofer), these speakers pack enough power for most situations.

The twin grey plastic speakers are powered by a heavy 45-watt power brick; Philips plans to replace it eventually with a slimline power supply. On the left speaker are the controls: a power switch, loud/soft buttons, DBB (Dynamic Bass Boost, which adds extra bass resonance), as well as Incredible Surround, an option unique to these speakers. Incredible Surround digitally creates a phantom, out-of-phase audio image area outside the speaker, which seemingly turns stereo into quad. The effect on the ears is truly stunning, especially considering that the speaker stereo

separation is only 2 to 4 feet. It's similar to the effect one gets with Spatializer, Qsound, and SRS technologies, although Philips makes use of an entirely different algorithm.

The USB Digital Multimedia Speakers plug directly into a USB port, bypassing the need for a separate sound card (except under Windows 95 OSR/2.1). In fact, they work off of the MMX instruction subset on Pentium, K6, and similar CPUs that directly process digital sound. Theoretically, all you need to do is attach them to a Windows 98 machine (they will not work under Windows 95), turn them on, and rev up the volume—the sound should then waft through the cloth grills. Unfortunately, it didn't work that way with the beta models we tested. After installing the driver, we had to click on Audio Properties manually and select the Philips USB speakers as the preferred playback device. With its shipping version, Philips will provide a graphical interface driver for installing and fine-tuning sound via on-screen programming.

Philips describes its USB speakers as high-end PC gaming and business speakers, although (with a range of 60 Hz to 20,000 MHz) they are also capable of producing high-quality music audio. The audio driver on the beta version of Windows 98 that we used to test the speakers did not consistently produce a continuous sound stream. Even though this does not matter much with sound effects and the like, it can be noticeable when you play classical music. The problem should be eliminated in the final Windows 98 shipping version.

The bass boost lends added oomph, with or without the subwoofer. And when you use it in conjunction with Incredible Surround, you may never want to go back to listening to the tinny sound of typical computer speakers.



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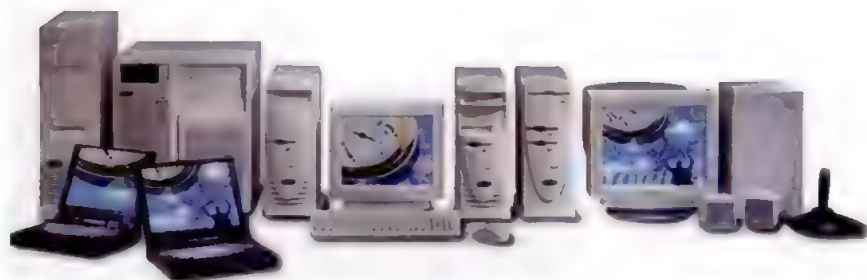


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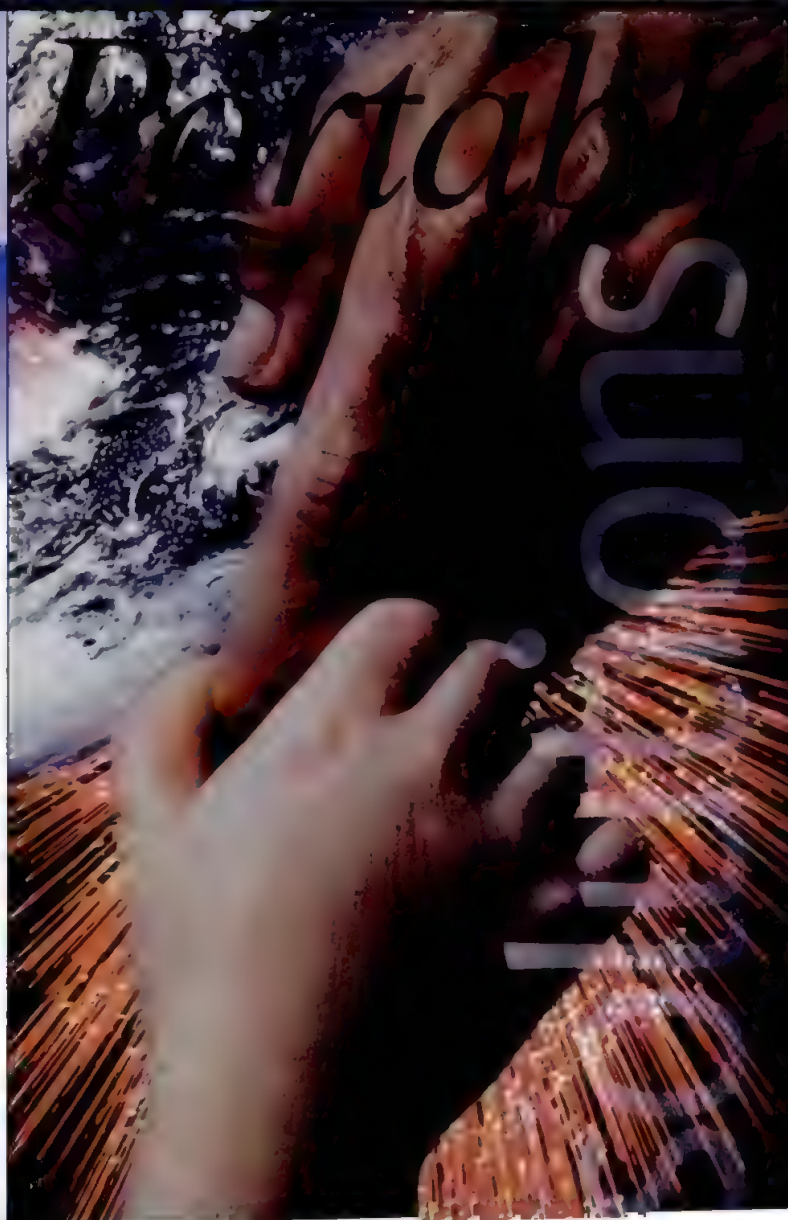
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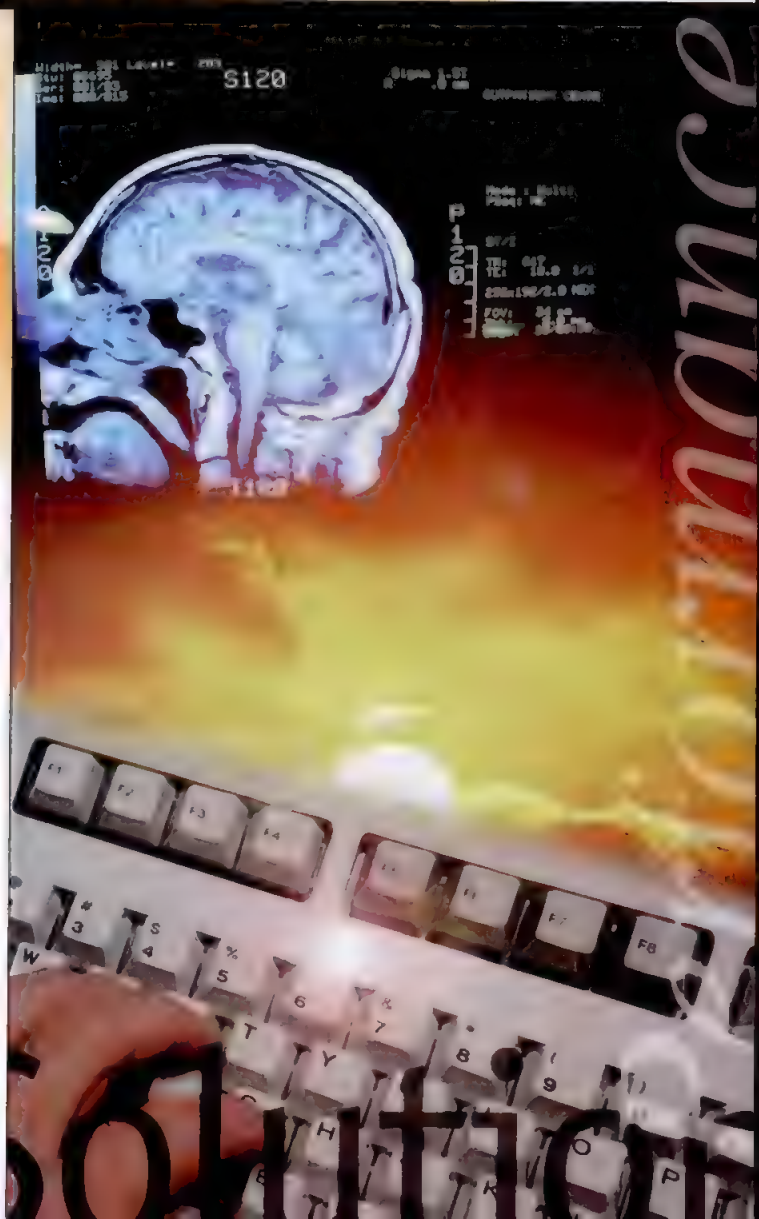
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STANDARD FEATURES

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512KB internal L2 cache, 2MB BIOS
Integrated 100MB Iomega Zip drive, 3.5" floppy drive
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Advent 009 speakers with subwoofer
3Com/US Robotics 56K x2 data/fax modem*
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Intel 300MHz Pentium II processor
(features MMX technology)
64MB SDRAM
6.4GB Ultra ATA hard drive
17" Micron 700FGx, .26dp
(16" display)

\$2,399

Bus. Lease \$84/mo.

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Intel 333MHz Pentium II processor
(features MMX technology)
64MB SDRAM
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19" Hitachi SuperScan CM751,
.26dp (18" display)

\$2,749

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Intel 233MHz Pentium® II processor
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NOS support (3 incident resolutions/1st year), 7x24

STANDARD FEATURES

Single or dual Intel Pentium II processors
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NOS support (3 incident resolutions/1st year), 7x24

STANDARD FEATURES

Single or dual Intel Pentium II processors
512KB integrated cache in SEC package
Memory: ECC EDO or SDRAM option
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Intel 166MHz Pentium processor with MMX technology
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CLIENTPRO MRE

Intel 233MHz Pentium processor with MMX® technology
32MB SDRAM
2.1GB SMART Ultra ATA hard drive
15" Micron 500Lx, .28dp (13.7" display)

STANDARD FEATURES

512KB pipeline burst cache, DMI compliant,
2MB flash BIOS
Network adapter with Wake-On-LAN technology
24X CD-ROM drive ATAPI variable speed
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Advanced hardware monitoring and power
management features
Chassis intrusion alert
Microsoft Windows NT Workstation
5-year/3-year Micron Power
limited warranty

\$1,549

Bus. Lease \$54/mo.

CLIENTPRO 766Xi

Intel 266MHz Pentium II processor featuring MMX technology
64MB SDRAM
3.2GB SMART Ultra ATA hard drive
17" Micron 700FGx, .28dp (16" display)

STANDARD FEATURES

512KB internal L2 secondary cache, DMI compliant,
2MB flash BIOS
24X ATAPI variable speed CD-ROM drive
Network Adapter with Wake-On-LAN technology
4MB AGP 3D video
Creative Labs Sound Blaster® 16 sound card w/speakers
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First Looks

Philips Consumer Electronics

Philips Brilliance 107

Philips' Brilliance monitors are high-quality, high-resolution devices designed for professional graphics applications; they probably would be overkill for business users and home consumers, though. Having said that, we still feel the Philips Brilliance 107 (\$570 street) is one of the best 17-inch monitors we've seen. Its optional \$60 USB hub and interface is extra frosting on the cake.

The Brilliance 107's viewable area is 16 inches; other features include 1,600-by-1,200 resolution at 76 Hz (which can be bumped up to 1,800-by-1,440 with a low 63-Hz refresh rate and corresponding high-end graphics card), a razor-sharp 0.22-mm dot pitch, and both D-Sub and BNC connectors. The CRT itself is a Hitachi tube with a special clear coating and Invar shadow-mask technology for higher contrast and sharper characters. Since it uses a self-converging yoke that continually optimizes itself, there's no need for manual focus.

The Brilliance 107 also comes equipped with business-audio-quality built-in speakers and microphone, external audio input and output jacks, a PC-to-Mac adapter, and Colorific, a color-management program for calibrating the monitor.

Setting up the optional USB central hub takes only a minute. You insert the device in the back of the monitor and tighten a single screw. The hub has four ports, and because it's powered, it can be used for attaching printers, scanners, cameras, and other devices with moderate electrical power draws. The included CD-ROM easily initializes both the monitor and the hub, although plug-and-play installation works only when the monitor is inter-

faced through the D-Sub (VGA) cable and not through the BNC cable. For that, you'll have to install the software manually.

Because USB is a two-way signal, you can easily use the monitor's software to make on-screen adjustments by attaching the monitor's USB port to the computer. This is a fairly common feature in high-end graphics monitors, but such fine tuning is usually done through the graphics board or a serial port. The Brilliance 107's on-screen adjustments

tures and the ultra-high resolution of the Philips Brilliance 107, it will please most non-graphics professionals who want an easy-to-set-up, easy-to-look-at, trouble-free CRT with a powered USB hub.

The Princeton E0710U monitor has a 0.26-mm dot pitch and a maximum resolution of 1,280-by-1,024, with a viewable area of 16 inches. At 35 pounds, the monitor itself is fairly light, and with its 12-inch circular base it has a relatively small footprint. It also has au-

than choose from a handful of presets or play with sliders. But once you find yourself accustomed to making on-screen adjustments, you will never want to return to pushing buttons on the monitor.

Colors on the E0710U are crisp, well-saturated, and accu-

Princeton E0710U

Street price: \$600

Princeton Graphic Systems,
Sunnyvale, CA,
800-747-8246,
714-751-8485

www.pgr.com

Choose 418 at
www.pcmag.com/info/lini



Philips Brilliance 107

Street price: \$570

(\$60 for optional
USB hub)

Philips Consumer
Electronics
Atlanta, GA, 800-835-3506
423-475-0624

www.philipsmonitors.com

Choose 417 at
www.pcmag.com/info/lini

HOOK IT UP: An optional powered hub provides four USB ports to the Philips Brilliance 107 monitor.

rate, and text is sharp and dark. The screen is bright and waver-free. We enjoyed using the E0710U, and we especially appreciated its lightweight and compact dimensions when we shifted it among our test systems.

duplicate the same parameter changes that can be made with the buttons on the front of the monitor (only they are easier to operate and the control is more precise).

What is lacking is specific provision for a hardware calibration device—as good as Colorific is, it can't calibrate to a scanner, monitor, or printer, and it relies too much on the user's eyesight and color perception. Philips says that it's possible for a third party to make a product that does calibration via USB to interact with the Brilliance monitor.

If you have the need for USB, the Philips Brilliance 107 is the monitor you'll want on your desktop.

Princeton Graphic Systems

Princeton E0710U

Although the Princeton E0710U 17-inch monitor (\$600 street) doesn't have all the fea-

tomatic display power down, an environmentally friendly ability to save electricity. Although Princeton uses antiglare coating, it doesn't do much to cut down on hard reflections. On either side of the front bezel are two USB ports, for a total of four ports. Windows 95 and 98 both had no difficulty recognizing and initializing the monitor as a plug-and-play device.

Like the Brilliance 107, the Princeton E0710U's adjustments can be configured through the front panel or on-screen via the USB port. There are not as many user controls, but Coloright, the hardware-based color calibration scheme, is very easy to set. Coloright allows users to change the color temperature to orient the monitor in different lighting environments, but we would rather have the ability to input a specific number rather

Storm Technology PageScan USB

Originally produced by Logitech is Storm Technology's PageScan USB (\$200 street). (Logitech has since sold its scanner division to Storm.) The 2-pound, purple-colored PageScan is a 24-bit, 300-dpi color scanner requiring a Pentium/MMX or comparable CPU to function properly.

The PageScan is only slightly wider than a sheet of letter-size paper, with a tiny footprint that fits easily on top of a monitor. You can also use its 4-foot nondetachable cord to position it almost anywhere on the desktop. There's no power cord, on/off switch, or start/stop switch; the unit is entirely powered by the USB connection. In fact, the only physical control on the scanner is a reset button on top.

Once the PageScan is at-



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And before the stock ticker turns? Review wireless updates, check your puts, review your calls, or send an e-mail to your broker. And see how much Windows CE 2.0 turns downtime into uptime, anytime.

To find out more information about Handheld PCs powered by Microsoft Windows CE or for the name of a reseller near you, go to www.microsoft.com/windowsce/hpc/.

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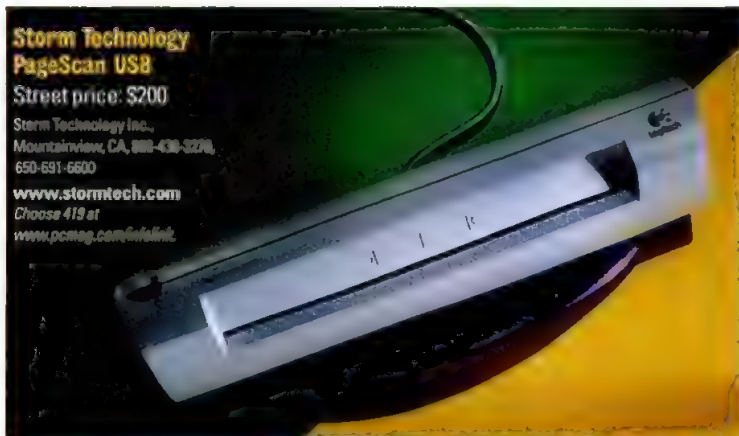
First Looks

Storm Technology PageScan USB

Street price: \$200

Storm Technology Inc.,
Mountainview, CA, 950-438-3276,
650-691-6600

www.stormtech.com
Choose 419 at
www.pcmag.com/sidekick



tached, Windows prompts you for the PageScan software, which installs as a Twain device. You can use the unit either with Storm's ScanBank software or with the bundled copy of Adobe PhotoDeluxe 1.0.

During testing, we found that this device functioned erratically under Windows 98 Beta 3. Attach it to a Windows 95 machine running OSR/2 Rev B, though, and you'll instantly have a quick, easy, and versatile color scanner.

After you initialize and calibrate the device, it's ready to start scanning. Feeding paper into the narrow front slit will activate the transport motor and grip the paper so that it won't fall out. There is no warm-up time, and scans are surprisingly fast. PageScan is an easy-to-use, output-driven OCR and image-scanning program that offers a minimum of prescan tools. To scan, you choose the type of original document you're scanning, pick the resolution, select whether text is in the original, and choose a target or destination for the scan (a word processing document, fax, PhotoDeluxe template, or printer). Cropping and rotating are accomplished by manipulating handles on the prescan image.

For a sheet-fed scanner, the PageScan USB produces sharp, accurate colors and excellent detail in highlights and shadows. Even the software interpolation helps enhance image quality, a relative rarity among nonprofes-

sional scanners. Unfortunately, the PageScan USB had consistent difficulty with highly polished originals, such as glossy photographs and slick magazine pages. Every photo and magazine page we fed through the scanner skewed, creating unacceptably distorted images.

Higher-resolution, higher-bit-depth flat-

bed scanners sell for \$100 less than the PageScan USB, so buyers would be advised to look elsewhere for a scanner capable of correctly inputting photos and magazine pages.

3Com Corp.

U.S. Robotics 56K Voice Faxmodem

3Com's U.S. Robotics division is known for producing superior, premium-priced modems, and the vendor's 56K Voice Faxmodem (\$250 street) is no exception.

The 56K Voice Faxmodem is a dark gray, book-size, asymmetrically styled external device that can function as a modem, fax, and full-duplex speakerphone. Because the modem requires 2,100 mA of electricity to function properly, it's externally powered by an AC adapter. If your computer isn't yet USB- and Windows 98-equipped, the 56K Voice Faxmodem can be at-

tached and operated as a standard serial modem.

The 56K Voice Faxmodem is equipped with an on/off switch, a built-in microphone and speaker, volume control, and speaker/mute buttons. Like other higher-speed U.S. Robotics modems, the 56K Voice Faxmodem uses x2 technology to help minimize or eliminate data errors; the modem is software-upgradeable to the new 56K ITU standard. You'll need to purchase either a 25-pin serial cable or a USB cable, both of which are available at almost any computer store.

Windows 98 Beta 3 immediately recognized the modem, but it attempted to install it as COM5. We tried to change the 56K Voice Faxmodem's configuration manually from serial to USB, and although we seemed to select the correct port assignment successfully, the modem automatically reverted to the nonexistent COM5 whenever it was activated. The problem was the lack of a proper USB driver. It wasn't until 3Com sent us a new driver that we were able to set up the modem successfully.

We had no further problems once we changed the port assignment to USB. Accessing e-mail, surfing the Net, and using the autodial and speakerphone all worked flawlessly. This device is now available as a standard serial modem, and (when Windows 98 is ready) it will easily be switched over to USB when the driver is released. **PC**

U.S. Robotics 56K Voice Faxmodem

Street price: \$250

3Com Corp., Stokio, IL,
800-342-5177, 847-882-5161

www.3com.com
Choose 420 at
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USB Tip

Every USB device has a unique firmware identification code that handshakes with the interface and reports such things as the device serial number, driver requirements, and power draw to Windows 98. If the power requirement exceeds 100 mA, Windows is supposed to flash an exclamation point on a yellow background. A right mouse click will reveal an error message that there isn't enough power available.

The solution is either to unplug one or more USB devices or use an independent power supply for that particular peripheral. Nevertheless, Windows 95 OSR/2 Rev B and early Windows 98 betas did not have this particular feature implemented, so when we plugged in any device that exceeded 100 mA and wasn't independently powered, the computer failed to see it. It took considerable sleuthing to figure out why a particular peripheral couldn't be made to work.

For more information about USB and whether your system's version of Windows is USB-compatible, visit the USB Consortium Web site at www.usb.org.

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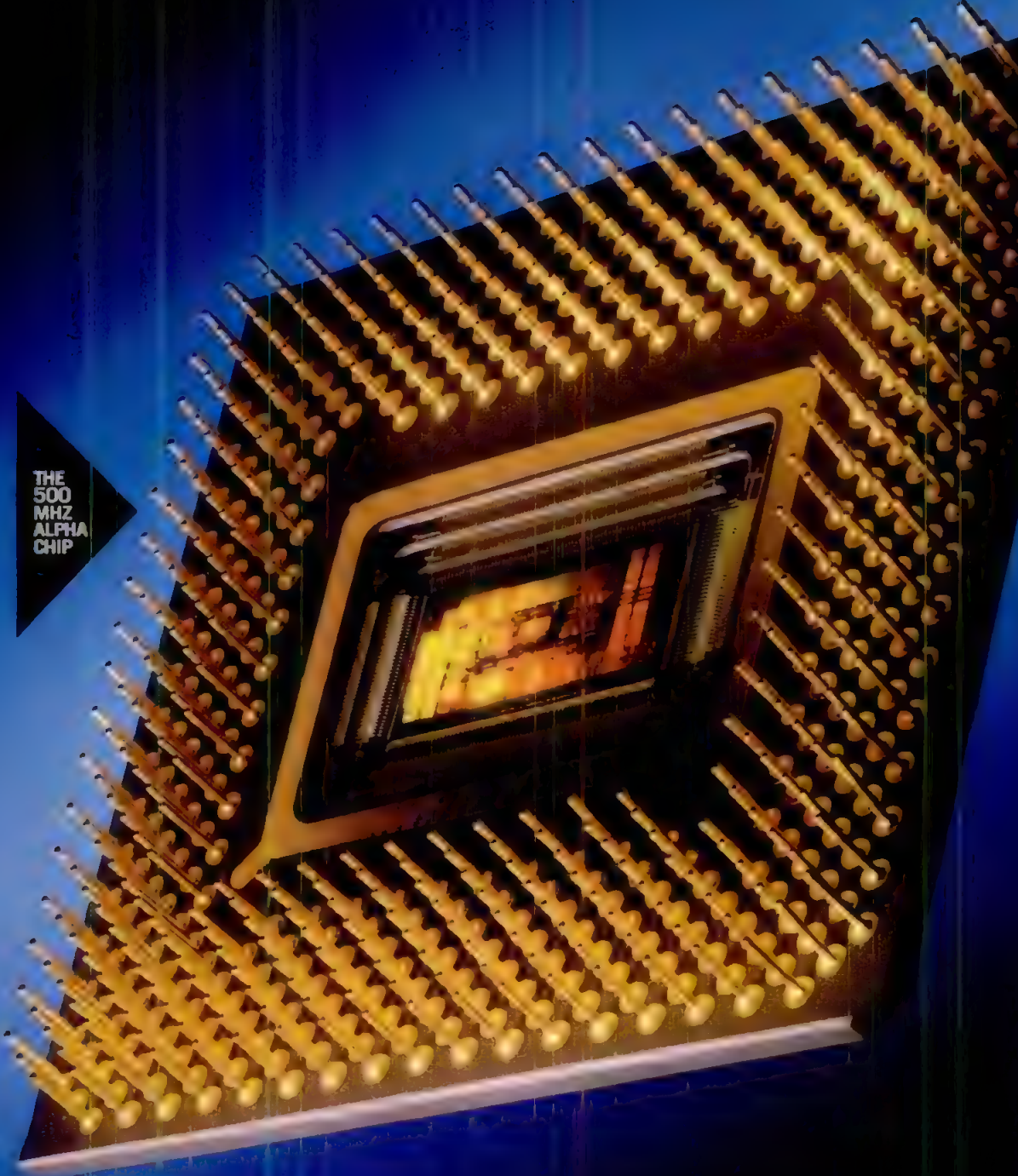
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First Looks

NOTEBOOKS

Potent Portégé

Toshiba picks up the speed to 266 MHz and adds a 4GB hard disk to its latest ultra-lightweight notebook.

By Carol Venezia

If your mobile-computing needs demand maximum power in a minimal package, Toshiba's Portégé 320CT (\$3,700 street) may fit the bill. This machine is just a bit larger than a hardback novel and weighs in at only 3.8 pounds with its primary battery installed. But don't let the diminutive size fool you: Under the hood, the Portégé packs a 266-MHz Pentium/MMX processor, 512K of pipelined-burst SRAM, and a 4GB hard disk.

To get the most out of this system, you'll have to carry a few pieces with you, but fully assembled the Portégé is still smaller than standard notebook fare. The base unit (4.4 pounds with AC adapter) features an integrated K56flex voice/data/fax modem with DSVD support, a single USB port, two Type II CardBus- and ZV Card-ready slots, a FastIR transceiver, and an SVGA-out port.

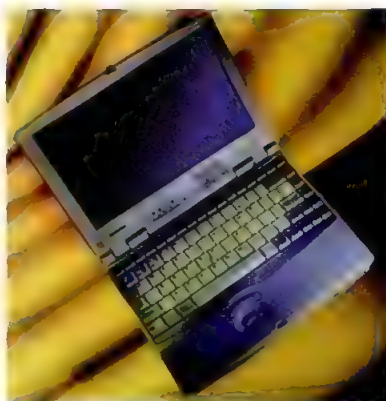
To connect further, you'll have to add the included Port Expander. This piece adds serial, parallel, and keyboard ports as well as a connector for the system's outboard, half-pound floppy disk drive. The Port Expander is a bit klunky (jutting out about an inch from the notebook) but functional.

Flip open the lid of the Portégé and you'll find a panoramic, 10.4-inch-diagonal active-matrix screen. Driven by a Chips & Technologies' 65555 graphics accelerator with 2MB of EDO DRAM, this panel has a native resolution of 1,024-by-600; you can also enable LCD stretch-through software, which gives you a virtual 10-by-7 desktop. The panel's 16:9 aspect ratio may be a bit tough to get used

to, but you'll appreciate it on an airplane in coach class behind someone who insists on flinging back his seat at unannounced intervals.

On our BatteryMark test—the most important performance metric for a machine of this class—the Portégé's 2,400-mAh lithium-ion battery lasted 2:15. To extend battery life further, you can purchase the optional high-capacity 3,600-mAh pack (\$200 street), which should give you 3.5 hours of juice.

Another option worth considering is the Multimedia Port



LIGHTEN UP: The Toshiba Portégé weighs in at only 3.8 pounds.

Replicator (\$480 street). Weighing just two pounds, this "slice" adds a 20X max CD-ROM drive, stereo speakers, a second USB port, the same ports as the Port Expander, SVGA-out, and line in/out jacks. If you carry this

piece with you, the entire unit is still only 2 by 10 by 8.25 inches (HWD).

Toshiba preloads the DMI 2.0- and ACPI-compliant Portégé with Intel's LANDesk Client Manager, Puma's Intelli-Sync 97 for IR transfers, and Ring Zero Systems' RingCentral for centralized communications.

For the power-hungry road warrior, the Toshiba Portégé 320CT is a must.

Toshiba Portégé 320CT. Street price: \$3,700 with

266-MHz Pentium/MMX CPU, 32MB RAM, 4GB hard disk. Toshiba America Information Systems Inc., Irvine, CA; 800-334-3445; computers.toshiba.com. Choose 410 at www.pcmag.com/infolink.

3-D ANIMATION TOOLS

Word Up

LogoMotion makes it simple to create 3-D animations and logos.

By Luisa Simone

LogoMotion 2.1 (\$99 list), from MetaCreations, is a 3-D modeling and animation program that has been optimized for the creation of flying logos and headlines. The combination

The LogoMotion control panel lets you switch among standard functions, such as defining object properties or choosing standard rendering options. It also gives you access to StageHands, LogoMotion's preformatted and pre-animated props, cameras, lights, and backdrops.

LogoMotion flattens the learning curve by limiting its toolset. The toolbox offers only three object-creation tools. The Text tool invokes a dialog box where you can type and format 3-D words, and the Lathe and Extrusion tools insert either a sphere or a cube into your scene.

In 3-D space, you can perform only basic manipulations, such as move, scale, and rotate. Modifications to an object's shape are done in a Workshop window, where you edit 2-D splines. LogoMotion automatically rotates or extrudes the outline into a 3-D object.

This allows anyone familiar with vector illustration programs to create custom objects.

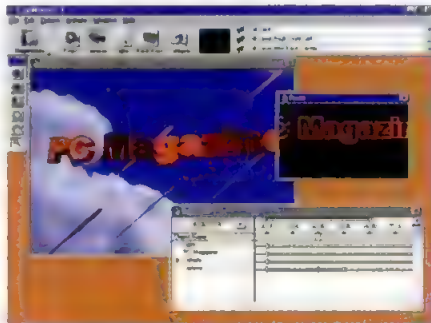
LogoMotion's more advanced functions are still easy

to use. The Sequencer presents a timeline where you can orchestrate the events in an animation. But it also uses a simple outline paradigm to create hierarchical relationships between objects.

LogoMotion's support of texture maps, environment maps, and cast shadows makes it possible to generate highly realistic images. We rendered perfect AVI movies using the basic Microsoft Video 1 codec. The lack of GIF support is a serious disappointment, forcing you to convert anything before posting it on the Web. During testing, LogoMotion generated PNG and PSD still images without a hitch, but it could not generate readable TIFF or JPEG files.

Even with these shortcomings, LogoMotion makes 3-D modeling and animation both affordable and accessible.

LogoMotion 2.1. List price: \$99. Requires: 16MB RAM, 30MB hard disk space, 16-bit video adapter, Microsoft Windows 95 or NT 4.0 or higher. MetaCreations Corp., Scotts Valley, CA; 408-430-4000, 800-846-0111; www.metacreations.com. Choose 411 at www.pcmag.com/infolink.



DRAG AND DROP: Create complex animations with LogoMotion's StageHands.

of an innovative interface, pre-animated components, and a powerful rendering engine lets even novice designers generate high-quality movies.

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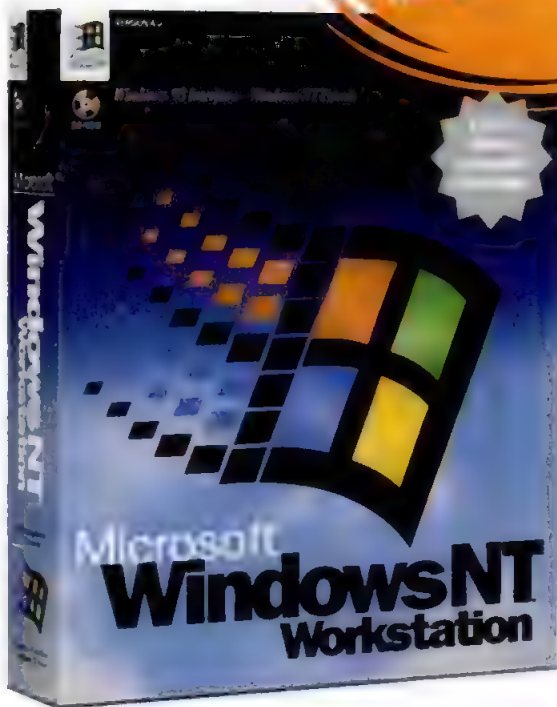


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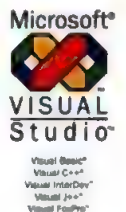
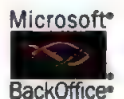


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First Looks

BIOMETRICS

Anatomically Correct

Affordable biometric security devices use voice, fingerprint, and facial recognition to secure your PC.

By Bruce Brown

If you've visited an ATM recently, you may have already experienced biometric authentication. Some banks are now experimenting with face-recognition systems. Advances in biometrics and faster PCs now make it possible (and economical) to use a variety of biometric authentication technologies on PC LANs and even standalone PCs in small business and home settings.

To some people, using biometrics may seem like overkill, but password protection has significant drawbacks. Passwords can be forgotten, stolen, or simply a pain to type. But if your face is the key to starting your system, you won't forget it, no one can steal it, and all that's involved is looking at a camera. If you want added protection without breaking budgets or seeming like the NSA, consider using multiple levels of security: a password and a biometric, for example. Or go further and combine two biometrics, such as face and voice, in addition to a password.

We tested five of the newest products available for securing your PC, including fingerprint, voice, and face recognition. All of the devices we looked at were under \$700, and there are quite a few solutions for under \$100.

BIO_MOUSE

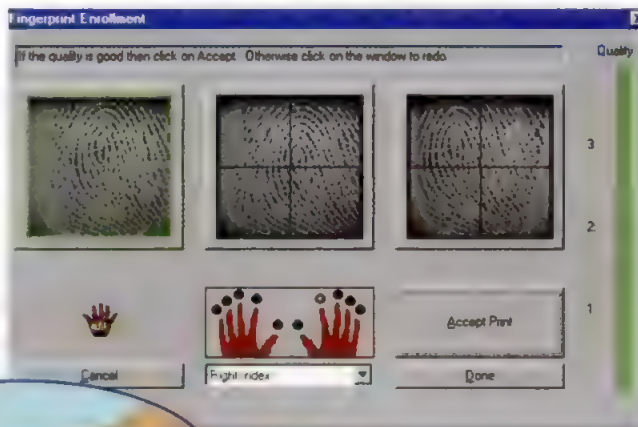
American Biometric's BioMouse Desktop Fingerprint Scanner (\$299) is a fingerprint-authentication system with a proprietary matching algorithm targeted for a wide range of business and personal settings.

The BioMouse system doesn't store fingerprints, but it saves reference feature files based on gray-scale images of fingerprints. These are not compatible with police systems, and thus they protect individual privacy.

The BioMouse scanner connects to a PC via a parallel-port pass-through connector. It comes with software for Microsoft Windows 95 or NT 4.0.

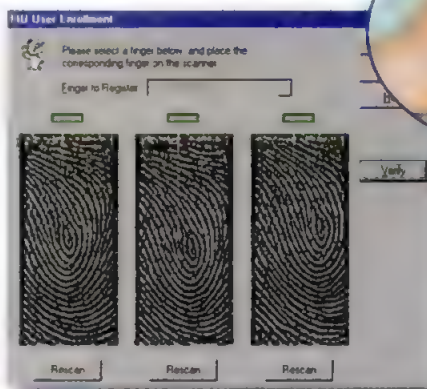
Users can train the BioMouse with one, several, or all ten fingers. After training, any of the enrolled fingerprints can be used to start the Windows Desktop or secured applications or files. Three impressions are taken of each finger to be enrolled, with an on-screen display window that helps center the impression.

The trickiest part of using



THUMBS UP! American Biometric's BioMouse uses three fingerprint samples to register proprietary format reference files for users.

the BioMouse is finding a convenient and comfortable location for the device and then getting used to pressing the enrolled fingers on the screen correctly. With a bit of practice, we found this system to be as fast or faster than entering a password.



IT'S ALIVE! I/O Software's Puppy Secure Logon System stores fingerprint patterns and other biometrics to distinguish live fingers from a latex glove or a dead finger.

BioMouse Desktop Fingerprint Scanner. List price: \$299. Requires: 486-based PC or better, 16MB RAM (32MB for Windows NT), 1MB hard disk space, parallel port, Microsoft Windows 95 or NT 4.0. American Biometric Co., Ottawa, Ontario, Canada; 888-246-6687, 613-736-5100; www.abio.com. Choose 405 at www.pcmag.com/infolink.

PUPPY SECURE

I/O Software's Puppy Secure Logon System for Windows NT (\$650 list) is a step up from the BioMouse in price and hardware features. The system is actually owned by Sony Corp., and the software was developed and is supported by I/O Software.



Sony's Fingerprint Identification Unit (FIU), a.k.a. the Puppy, is a self-contained unit with a Hitachi H8 CPU (comparable to a 386) and 4MB of nonvolatile Flash- RAM. It can store 1,000 fingerprint templates with processing via an ASIC

in the Puppy itself. (An OS-independent standalone version that runs via an ISA card will be available in mid-April.)

The Puppy connects to a PC via a serial port. As with the BioMouse, you train the Puppy by scanning three fingerprint impressions; a verification step evaluates each impression, requiring you to rescan until you get three good impressions. The software is adaptive and re-trained with use, so scars, abrasions, and dry skin won't throw it off. You can train all ten fingers, but only one finger is necessary to gain access to the system.

The I/O system features multiple verification levels and has the ability to detect a live finger. As with the BioMouse, practice in placing your finger correctly on the Puppy soon pays off with fast recognition. An SDK is available for \$1,500 (including an FIU) for developers who want to create software or systems with the Puppy authentication system.

Puppy Secure Logon System for Windows NT. List price: \$650 (client/server version, one fingerprint unit, and Windows NT logon software). Requires: 16MB RAM, 5MB hard disk space, serial port, Windows NT 3.51 or 4.0. I/O Software Inc., Riverside, CA; 800-800-7970, 909-222-7600, www.iosoftware.com. Choose 406 at www.pcmag.com/infolink.

FACEIT PC

Visionics Corp.'s FaceIt PC 3.0 (\$99 list), currently available only for Windows 95 (an NT version should be available by the time you read this), captures facial images from moving figures and builds a database of images for comparison. You need a video capture card and at least a moderate-quality video camera for good image capturing and recognition accuracy.

Tested with a U.S. Robotics Bigpicture Video Camera and Capture card, FaceIt PC was a pleasure to use. During the enrollment process, the software searches for faces in the video image, using a red circle to find and indicate a face. After capturing three photos, the software grabs more images until it has enough to create a valid and reliable reference entry.

After enrollment, FaceIt searches the camera's view whenever you start your system. It uses a nonintrusive, automatic process that can discriminate between photographs or masks (a lack of movement causes recognition failure). Additional features include FaceIt Cipher (a D.E.S. file-encryption feature) and an audit log of those who have succeeded and failed to gain access to the system.

FaceIt PC 3.0. List price: \$99. Requires: 16MB RAM, 10MB hard disk space, Microsoft Video for Windows capture system (5-fps,



TAKE THREE: Visionics' FaceIt PC starts with three facial images and then adds additional shots to store a recognizable reference set.

15-bit RGB, 320-by-240 resolution camera recommended), Windows 95. Visionics Corp., Jersey City, NJ, 201-332-9213; fax: 201-332-9313; www.faceit.com. Choose 407 at www.pcmag.com/infolink.

TRUEFACE PC

Miros Inc.'s TrueFace PC (\$59.95 direct) comes in versions for Windows 95 and NT and Sun Solaris. It works by storing a series of still images cross-referenced with a user name or PIN. Unlike FaceIt PC, TrueFace PC can work with PC cameras available for under \$100, such as the QuickCAM VC. The basic specification required for images for TrueFace PC is a minimum face height of 80 pixels of 8-bit gray scale.

When you enroll faces with the Miros system, users enter their names and hold still for a series of single shots. The software tries to frame the subject's face with a green rectangle, giving the sub-

ject or enrollment personnel the opportunity to add the framed image to the database. At least three images are required, although the program will add more as the subject uses the system.

After enrollment, the system works by capturing two images from a video clip to compare to the reference database entry. By using two images, the system is able to defeat someone holding up a photograph, because there must be a difference in the images.

TrueFace PC is the less expensive facial-recognition system of the two evaluated and still provides fast enrollment and recognition. It is also currently available for a wider variety of operating systems.

TrueFace PC. Direct price: \$59.95 download, \$99.95 via phone. Requires: 16MB RAM, 10MB hard disk space, Video for Windows compatible card or camera, Windows 95 or NT. Miros Inc., Wellesley, MA; 781-235-0330; fax: 781-235-0720; www.miros.com. Choose 408 at www.pcmag.com/infolink.

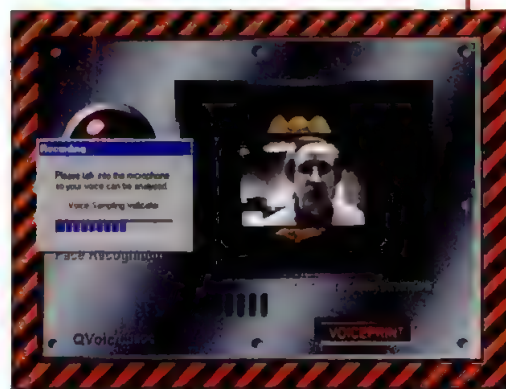
STAR TREK BIOMETRIC SECURITY

QVoice Inc.'s Star Trek Biometric Security (\$80 street) is a combination voice- and facial-recognition system targeted at Windows 95 notebook users (QVoice will be adding fingerprint recognition later this year). The QVoice product uses Visionics' facial-recognition engine, but it has its own interface and different features. Star Trek-themed Star Trek Biometric Security comes complete with Star Trek graphics, audio, and video tracks. Another version of the program

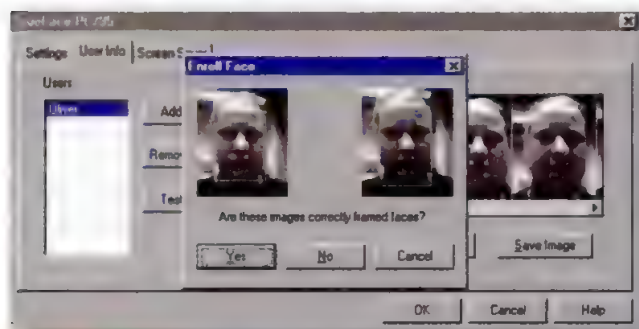
(called Who Is It!) is available for non-Trekkies.

You can select voice recognition, facial recognition, password protection, or any combination of the three. The facial-image enrollment process uses moving circles to find and capture face shots, and the voice-recognition system presents a short selection of sentences to read. When you use a computer with both biometrics stored, facial recognition must be successful before voice recognition can be attempted. The program saves voice and facial files of people attempting unauthorized access and sounds a loud alarm.

The QVoice product can also be used to restrict access to programs and to encrypt and decrypt directories. A parental-control program lets you set up a profile that restricts game play-



ENTERPRISING: QVoice's Star Trek Biometric Security System uses a combination of face identification, voice print, and passwords.



FACIAL FEATURES: Miros Inc.'s TrueFace PC lets you store multiple facial images to increase recognition accuracy.

ing or Internet surfing but allows word processing, for example. **Star Trek Biometric Security.** Street price: \$80 for a single user, \$20 for each additional user. Requires: 8MB RAM, 5MB hard disk space, Creative Labs Sound Blaster-compatible audio card, microphone, video capture card, 320-by-240 resolution video camera, Windows 95 or NT. QVoice Inc., Andover, NJ; 973-786-6878; fax: 973-786-5868; www.qvtrek.com. Choose 409 at www.pcmag.com/infolink.



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INTERNET MULTIMEDIA

Real Streaming Tools

A new encoding suite from RealNetworks makes publishing streaming media easier than ever.

By Jan Ozer

RealNetworks' new encoding suite removes most technical barriers from publishing streaming media. At the core is RealPublisher 5.1 (\$49.99 list), which automates encoding, HTML creation, and FTP uploading. New Microsoft PowerPoint 97 and Adobe Premiere plug-ins (\$39.99 and \$99.99 list, respectively) automate publishing from those programs while creating new mediums for RealNetworks' technology. Combined, these new tools make RealMedia both easier to use and more useful.

RealNetworks recently made two changes to entice new developers. First, it stopped charging for certain product configurations, letting any company install basic audio and video streaming for free. Second, it enabled its products to work without a dedicated server, simplifying deployment for companies without Web servers.

Although significant, these moves didn't make it easier to encode or publish RealMedia files. This is a key issue addressed by the new products (which don't upgrade the core audio-video compression technology). Another issue involves expanding the range of media types that RealSystem comprehends.

REALPUBLISHER

RealPublisher 5.1 is a polished tool that delivers advanced functionality while hiding technical details. A wizard asks you several questions to derive encoding parameters such as frame rate, audio codec, and total bandwidth. When finished,

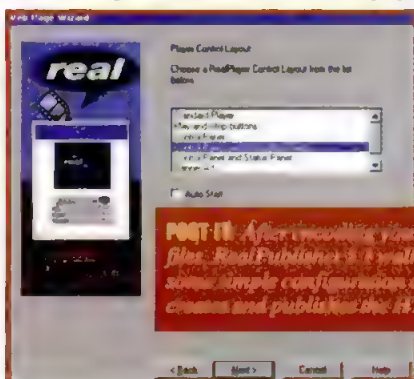
you end up at the main program window, where you can change any parameter.

After encoding, you can either e-mail a file using any MAPI-enabled program or publish on the Web via an HTML-creation wizard that produces both the HTML page

and the required token file. Finally, a publishing wizard uploads the page by using FTP. This strips directory information so that file pointers match your Web site.

The program is not without its limitations, though. RealPublisher offers no general design options, so you'll have to use your HTML editor to make your pages conform in appearance. In addition, RealPublisher uploads all files to the Web root; you can't set a target directory. This approach may not work for many developers.

Still, the default values are ideal for novices who simply want video on their Web sites, and advanced developers can copy the relevant HTML code into their own pages and manually set file pointers. The net result is an easier production job for developers at all levels.



NOW SHOWING: RealNetworks' *Premiere plug-in* lets you encode and publish from within *Adobe Premiere* and create custom slide shows from your video files.

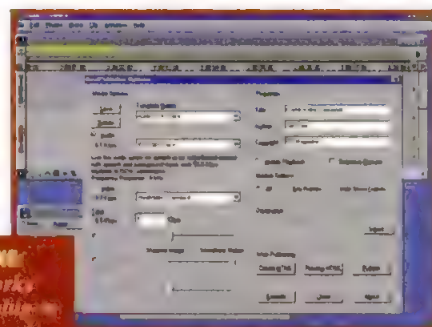
POWERPOINT PLUG-IN

The new RealPresenter plug-in for PowerPoint 97 introduces RealNetworks' ability to convert PowerPoint slides and audio into RealVideo files. You create your presentation and import narration tracks using standard PowerPoint controls, and then you run the plug-in from the tools menu.

A wizard asks you some simple questions in order to configure your output, and then it exports each slide as a JPEG frame, encodes the audio, and interleaves the two into a synchronized stream. You can then access the same e-mail and Web publishing functions available with RealPublisher.

We tested the PowerPoint plug-in with files from our recent roundup of Web-based multimedia presentation programs ("A Medium for Your Message," March 10, 1998), testing proficiency with both text- and image-based presentations. RealPresenter proved very easy to use and produced great audio quality.

Our only complaint concerned the slight JPEG arti-



facts we noticed in the text. But Microsoft NetShow Presenter (the only streaming alternative) suffered the same artifacts, and

RealNetworks' audio quality was much better. Anyone with a yen to place PowerPoint presentations on the Web will find this new plug-in to be an exciting alternative.

PREMIERE PLUG-IN

The Adobe Premiere plug-in has the same publishing options as RealPublisher, but its key feature is that it lets you create slide shows from videos and select the frames for the final video. This is important, because automatic conversions from 15 fps to 1 frame every 4 or 5 seconds invariably catch the subject with eyes closed or as otherwise less than photogenic.

You mark the keeper frames using standard controls in Premiere's clip window. You then access the plug-in from the export menu and select Slide Show Frames, which converts all marked frames to JPEG format, encodes the audio, and interleaves the two into a synchronized stream. Of course, you can also encode normally, with complete access to all encoding options.

RealNetworks' new tools extend a cushy welcome mat to new streaming-media developers and can serve as inexpensive time-savers for current RealSystem customers. They also dramatically extend RealNetworks' lead when it comes to these products' closest competitor, Microsoft

NetShow—especially now that RealNetworks has acquired VivoActive, the chief developer of NetShow tools. Until Microsoft makes NetShow more usable, RealNetworks will remain the only clear choice.

RealPublisher 5.1. List price: \$49.99.

RealPresenter Plug-in for PowerPoint 97. List price: \$39.99. **RealPublisher Plug-in for Premiere.** List price: \$99.99. Each requires: Microsoft Windows 95 or NT, 486/66 DX2, 8MB RAM, 4MB hard disk space, 16-bit color display, 16-bit sound card. RealNetworks, Seattle, WA; 800-444-8011, 206-674-2700; www.real.com. Choose 401 at www.pcmag.com/infolink.



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First Looks

BUSINESS GRAPHICS SOFTWARE

Get into Shape

SPSS's allClear 4.0 makes creating and updating business flowcharts quick and easy.

By David Haskin

Version 4.0 of SPSS's allClear (\$395 list) offers some novel twists that help speed the process of creating business diagrams. If you need to create organization charts and flowcharts quickly and easily, allClear is a simple choice.

allClear resembles programs like Visio in that it has palettes of commonly used shapes. You drag shapes from the palette to the diagram and then connect them with smart lines, which stay attached even when you move the shapes. But the allClear palette also has clusters of connected shapes, such as those for the steps in a decision-making process.

You add text to shapes by double-clicking on them, and formatting is done through menu or toolbar options. You

can link shapes to URLs or text files, and each shape can have data fields, such as the cost of each step in a process. But unlike Visio, allClear cannot display on-screen reports based on that data.

allClear also distinguishes itself from its competitors by letting you develop charts via a text outline in the window to the right of the diagram (similar to the outline view in a word processor). Top-level headings in the outline correspond to higher-level shapes in the diagram, and text subtopics are subordinate shapes. As you add text in the outline, the corresponding shape

appears in the diagram, connected appropriately to other shapes. Similarly, as you add shapes in the diagram, corresponding lines of text appear in the outline.

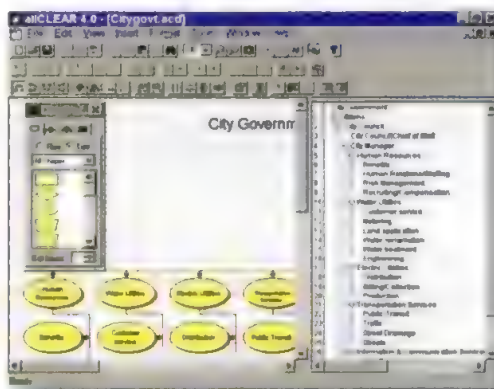
Using outlines is faster than

marks (inserting a backslash at the end of a line adds three subordinate shapes, for example).

As you create text outlines, the program notifies you if you do something illogical. But unlike

previous versions, allClear no longer checks for consistency and completion, such as starting but not finishing a yes/no sequence.

An included viewer lets others without allClear view your chart. You can also save a chart in Microsoft Excel and a variety of graphics formats, but not in HTML. Though allClear lacks the database capabilities of Visio, it offers greater speed when developing business diagrams.



WORD: allClear differs from other business graphics in that you can develop charts by creating the text outline shown in the right viewing pane.

dragging, dropping, and adding text to shapes, because those actions occur automatically when you type text and press Enter. You can speed the process further with allClear's simple macro language, which uses punctuation

allClear 4.0. List price: \$395. Requires: 16MB RAM, 10MB disk space, Microsoft Windows 95 or NT 4.0. SPSS Inc., Chicago, IL; 800-543-2185; 312-329-2400; www.spss.com. Choose 403 at www.pcmag.com/infolink.

PERIPHERALS

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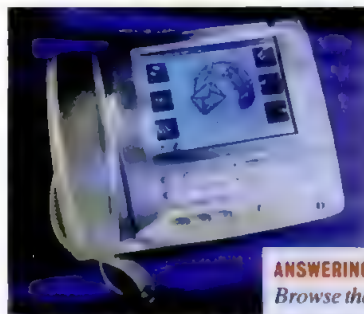
The Cidco iPhone combines phone service, e-mail, and Web access in one desktop package.

By Troy Dreier

Welcome to the age of the Internet appliance. In the next few years, expect to be bombarded with gee-whiz miniature computers that connect you to the Web in new and useful ways. Early on the scene is Cidco's iPhone (\$499 list), which combines phone service, e-mail, and Web access in one desktop package.

Not much bigger than a standard telephone, the iPhone has a built-in 7.4-inch gray-scale backlit screen. Users select options with a stylus and input text on a 7-inch keyboard that pops out from the bottom of the phone.

When you first try to send e-mail or access the Web, you



ANSWERING E-MAIL: Browse the Web and compose e-mail right from the iPhone.

are guided through a registration process that sets up an account with Concentric, a national ISP. Users are given the choice of paying \$19.95 per month for the all-you-can-surf plan or \$9.95 per month for 10 hours (additional hours are \$1.95 each).

The iPhone is such a speedy Web surfer that it belies its 14.4-

Kbps modem. The secret lies in the server-side preprocessing of information. When a page is requested from the ISP, it is sent to servers that compress graphics and remove certain HTML codes. The browser doesn't understand Java or Dynamic HTML, and it can't accept cookies, load sounds, or support frames.

Users can have the iPhone check e-mail automatically twice a day. The phone can also check for mail from other POP accounts (but not from AOL or corporate mailboxes behind firewalls). But typing e-mail with the iPhone's itty-bitty keyboard is a chore. Using the Shift key is such an effort that we ended up typing only lowercase letters.

Like any first-generation product, the iPhone leaves room for improvement. Editing e-mail

would be easier if users could highlight text. We'd also like the phone to check for new mail from more than one e-mail account at a time and automatically check more than twice per day. And for those who want to talk and surf simultaneously, the iPhone should be able to connect to two phone lines. Some software and hardware improvements are already under way, though. For example, an optional keyboard (\$39.95 direct) should be available by the time you read this.

Although there are a variety of small snags, we found no major problems. All in all, the iPhone smoothly combines phone, Internet, and e-mail access in one small console. It's a well-designed product at a bargain price.

iPhone. List price: \$499. Cidco Inc., Morgan Hill, CA; 408-779-1162; fax: 408-779-3106; www.cidco.com. Circle 404 at www.pcmag.com/infolink.

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First Looks

DESKTOP PUBLISHING

Get Published

Microsoft Publisher 98 offers more automation than ever for business-style desktop publishing.

By Edward Mendelson

With more automation, convenience, and options than ever before—plus more visual elegance and pizzazz—Microsoft Publisher 98 (\$100 street) has an almost ideal desktop publishing feature set for the small-business, small-office, and student markets. Publisher 98 builds newsletters, Web sites, signs, forms, letterheads, and business cards with just a few keystrokes. Stylish built-in designs let users with no graphics training produce good-looking output, and the program's advanced formatting and convenience make it worth consideration by design professionals.

But for all its automated ease, Publisher still offers only limited customization. If you're happy with the hundreds of superb layouts that Microsoft provides, you'll be happy with Publisher 98. But if you want to create your own distinct publications, you should probably move up to a high-end package such as Adobe PageMaker.

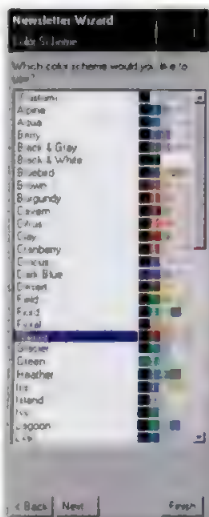
WIZARDRY

Like earlier versions, Publisher 98 lets you create publications by having you answer prompts from a wizard. But the new version replaces Microsoft's rigid wizard interface with a more flexible kind that resembles FrontPage's style gallery. With the old wizards, you made design choices only when creating a publication; afterward, you just had to live with them. With

the new wizards, you make initial choices from layouts and color schemes, but you can change them or the whole design at any time, even after a publication is complete.

Documents created by the wizards have dummy text and sample graphics. You click in a text field to insert your own text, and you click on a graphic to bring up Microsoft's ClipArt gallery, where you can choose from thousands of images. You can also add your own clip art to the gallery. After modifying a wizard's output to match the style you want, you can save it as a template for new documents, but you can't modify the choices you see when you run the wizards.

The editing window displays a single- or two-page spread, and it zooms between actual-size and full-page views. Also, optional cursors display the words *move* or *copy* so that you know what you can do with the current selection.



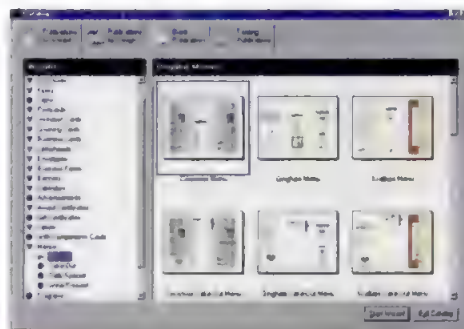
REDECORATE: You can change color schemes at any time while editing a Publisher 98 document.

On the left side of the screen are the wizard's formatting options, which you can close if you want to make document-wide changes. Help appears in either one or two panels on the right. But when a panel is open, very little real estate is left on-screen for edit-

ing; when both the wizard and the help panels are open, almost no room is left.

OFFICE-LIKE FEATURES

Publisher 98 looks more like Microsoft Office than ever, and it includes more of Office's features, such as the on-the-fly spelling correction used in Word, multilevel undo, and the same toolbars and irritating animated "assistants." Publisher 98 one-ups Office with a new table



GEE WHIZ: Publisher 98's wizards build everything from newsletters to paper airplanes to origami.

feature that can split a cell diagonally and apply different formats to each half rather than simply draw a line across the cell, as in WordPerfect. You can open a Publisher 98 document's text in Word for editing.

Publisher 98 lets you create four personal profiles, each with different data fields (such as those for name and telephone number) and design preferences (such as logo and color scheme). You can switch any publication from one profile to another; the data fields and design preferences change automatically. But you can assign data to a profile only by typing it into a document and then saving it. This almost guarantees that the wrong data will end up in one or more profiles, because you have to search two menus to find out a file's profile.

DEFAULT PROFILE NAMES

Other new features include automatic resizing of a headline font to fit into a banner or other design element and a logo-

creation wizard that combines the text and graphic you choose with prebuilt design elements such as ovals. Also, new font effects (which are based mostly on similar effects in Word) include outlining, drop caps, gradient fills, and rotation.

WEB PUBLISHING

With a few mouse clicks, you can modify a publication created for paper to publish it as a Web page. And when you change the name of any page, Publisher 98 (like FrontPage) automatically changes hyperlinks and page titles throughout the site. But you don't get access to underlying HTML code, and serious Web designers will prefer single-purpose Web editors such as FrontPage.

Beware of the form feature in Publisher 98. You can insert elaborate input forms in a Web page using the wizard, but when you save the document in HTML format, Publisher 98 warns that you will have to "work closely" with your ISP to get the forms to work. This is an understatement of the problem, because your ISP will have to install a script file available from Microsoft's Web site—something many low-priced ISPs won't do—and you may have to make some complex modifications to the script by hand.

Despite minor flaws, Microsoft Publisher 98 has no competition as a desktop publishing package for home and business use. Every Publisher user who can spare the disk space should get the upgrade.

Microsoft Publisher 98. Street price: \$100 (\$90 upgrade). Requires: Microsoft Windows 95 or NT 4.0 or later, 8MB RAM, 24MB–335MB hard disk space. Microsoft Corp., Redmond, WA; 800-426-9400, 425-882-8080; www.microsoft.com/publisher. Choose 400 at www.pcmag.com/infolink.



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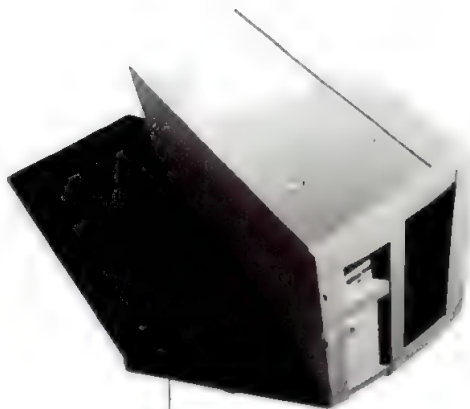
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First Looks

PERIPHERALS

Faster Multifunction

HP's LaserJet 3100 adds higher speeds and laser output to the company's line of multipurpose devices.

By Bruce Brown

In an initial but giant step, the HP LaserJet 3100 (\$700 street) is Hewlett-Packard's first move toward the page-printer multifunction market; previous all-in-one HP models were ink jet only. This monochrome, Windows-only printer/copier/fax/PC fax/scanner is a terrific value in its feeds and speeds, output quality, console and PC interfaces, and even operational costs. Small businesses, professional offices, and home settings that are looking for additional productivity at a reasonable cost would do well to consider the HP LaserJet 3100.

FEEDS AND SPEEDS

Using the same printing engine as the LaserJet 6L, the LaserJet 3100 features 6-ppm, 600-dpi printing and copying, 300-dpi optical scanning (600-dpi interpolated), and integrated standalone and PC faxing. The paper input and output trays can hold up to 100 sheets each. The fax and copier document tray flawlessly feeds 30 pages of originals. A 150-page or 2MB memory capacity lets you store outgoing or incoming faxes for later transmission or printing while you use the printer for other tasks.

The LaserJet 3100's most direct competitor is the long-praised Brother MFC-4550, which has higher (400-dpi) optical scanning resolution and the same printing resolution and speed. The major hardware differences between the two devices are that the HP

printer has almost no warm-up time (using an instant-on fuse), more fax memory (150 pages versus the Brother's 40 pages), and more than twice the rated duty cycle (6,000 pages per month for the HP and 2,500 pages for the Brother).

The 15.5- by 15- by 23-inch (HWD) LaserJet 3100 provides a two-meter cable with a small "C" parallel-port connector (note that you cannot use this printer plugged into a parallel port that is shared by other devices, such as external

laser pages come out of the printer face down in correct order, while ink jets need extra drying time and exit face up, one page on top of the other.

Printer output was comparable to typical 600-dpi laser printers. The HP's driver lets you adjust resolution and contrast quickly via two front-panel buttons, an LCD setup menu, or JetSuite's feature-rich software JetSuite Pro. When you put an original document in the LaserJet 3100's feeder, the first sheet automatically advances and the LCD panel prompts you to enter a fax number or the number of copies you would like to make (from 1 to 99). If the PC is

turned on, you can simply click on the icon for printing, scanning, faxing, or copying from a graphical interface.

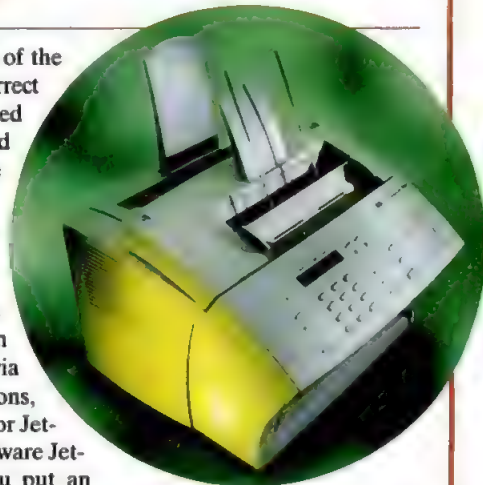
MAKING COPIES

The LaserJet 3100 can make up to 99 copies, with selectable collating and 50- to 200-percent reduction and enlargement. You can fax immediately from the

printer (with 175 programmable speed-dial numbers and 25 group lists) or schedule fax transmissions when phone rates are low. You can even feed new documents into the LaserJet 3100 for subsequent faxing while it is still transmitting an earlier fax. The JetSuite software also enables you to combine hard-copy source sheets and documents stored on your PC in outgoing faxes.

LASER PRINTER PLUSES

The HP printer was nearly silent in testing. The reasonably fast print engine (as compared to ink jet MFPs) was aided by the unit's instant-on feature and huge page buffer. One big advantage that laser printers have over ink jets is that the multipage copies don't need to be reshuffled—printed

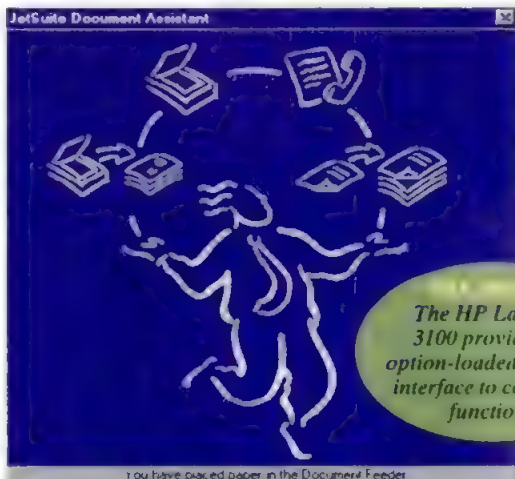


LASER SPEED: The LaserJet 3100, from Hewlett-Packard, prints, scans, copies, and faxes.

ReadIris Pro OCR software that features two levels of OCR. For quick and easy OCR scanning into major word processing programs (including Microsoft Word, Corel WordPerfect, and Lotus WordPro), the JetSuite Scan to Text button does a good job. But for more complex documents where you may want to use page definition to isolate or select areas to scan and recognize, you have the option of running the ReadIris application separately.

The HP LaserJet 3100 is backed by a one-year warranty that offers HP's Express Exchange program. If you are looking for a replacement or additional printer or copier and either do not need color output or already have a color printer, the HP LaserJet 3100 is a great choice.

HP LaserJet 3100. Street price: \$700. Requires: 486-based PC or better (Pentium/90 or better for Microsoft Windows NT), 16MB RAM, 30MB hard disk space, dedicated IEEE 1284-compliant bi-directional parallel port, Microsoft Windows 3.1x, 95, or NT 4.0. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; fax: 800-333-1917; www.hp.com. Choose 402 at www.pcmag.com/infolink.



The HP LaserJet 3100 provides an option-loaded but easy interface to configure functions.

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Second Looks

OMNIPAGE PRO 8.0

Retest by Default

By Diane Jecker

All optical character recognition (OCR) vendors claim to deliver the most accurate results, but finding the best program is no easy task. In our roundup "Word for Word" (*PC Magazine*, January 20, 1998), we took on that challenge.

To level the playing field, we scanned all images on our tests at a 1-bit pixel depth (black and white), saved them as TIFF files, and then imported them into each program. We chose 1-bit images for two reasons: Not all applications supported higher bit depths, and we felt that 8-bit scans are typically too slow for the average user. (For more on how we tested, see "Word for Word," page 198.)

8-BIT DEFAULT

Both Caere (the maker of OmniPage Pro 8.0) and a few of our readers have pointed out that because OmniPage defaults to scanning at 8-bits (256 shades of gray), our results might not represent what the average user encounters. OmniPage also overrides the scanner's default settings to optimize the image for recognition, so again our testing may not represent typical use.

Although OmniPage scans at 8 bits, it actually intelligently downsamples the image to 4 bits (16 shades) before recognizing the document, something it calls 3D OCR. (NewSoft's Presto! OCR Pro 3.0 downsamples 8-bit images to 1 bit—what it calls FinePage mode—but since this is not its default mode, we did not include it in our retesting.

We set out to answer three questions using OmniPage's default settings. Would 3D OCR improve OmniPage's results on our original test deck?

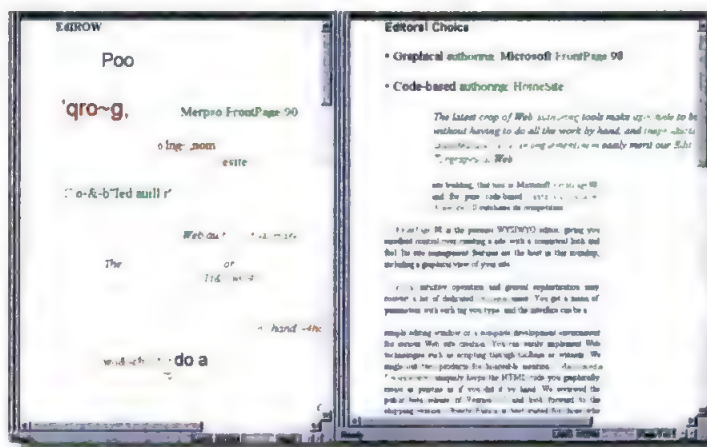
Would 3D OCR provide better results than 1 bit on difficult color documents? And would scanning directly into OmniPage provide better results

identify a pattern where one type of document scanned better than another. Scanning at 8 bit on our scanner did take an average of about 5 seconds longer per document (29 seconds versus 24 seconds). Recognition times varied by document.

Caere acknowledges that 3D OCR would probably produce

First we let OmniPage automatically zone the documents (that is, identify which part is text and which is graphics). In 1-bit scanning, the program never completely zoned a document properly and only three were partially accurate. In 3D OCR, the results were barely better. Two documents were zoned accurately and two others were partially accurate.

We then manually zoned the documents. We found it was necessary to zone the text as "Single Column," even if the document contained multiple columns. In the "Multiple Column" or "Mixed Pages" modes, the program still attempts to discern text from graphics, and on these documents it was usually wrong. This was an inconvenience when text wrapped around a graphic and multiple zones needed



BIT BY BIT: The same document (the original had black text on a purple background) scanned at 1 bit (left) and with OmniPage Pro's 3D OCR (right).

than importing TIFF files?

We retested with our original test deck, which consisted of 27 documents (33 total pages). We also used the same model scanner, a UMAX Astra 300P. Unfortunately, we could not use the same unit, so we performed another round of the original tests on the new scanner to establish a new baseline for comparison. To complete the new tests, with each document still in the scanner we scanned the image directly into OmniPage, first at 1 bit and then at 8 bits, allowing the OCR software to override the scanner's defaults as it deemed appropriate.

In general, the differences between any of the runs (the 1-bit import, the 1-bit scan into OmniPage, and the 8-bit scan into OmniPage) were inconsequential. All of the documents revealed some differences in the number of errors among the three scan types, but the differences were typically minimal. We could not

about ten percent more errors on very clean documents. To some extent, our testing bore this out. We found that on the cleanest documents, scanning at 1 bit tended to provide better results than 3D OCR. On less-clean documents, 3D OCR was generally better. We are reluctant to draw firm conclusions based on this breakdown, however, since reducing the number of documents (by including only clean or difficult documents) in the analysis decreases the statistical significance of the results.

A NEW DECK

So 3D OCR doesn't make much of a difference on good documents. But what about more difficult documents, such as those with colored text, inverted text, or text on a shaded background or graphic? We put together a small test deck of eight difficult documents to perform some informal testing.

ed to be drawn. But once 3D OCR was manually zoned, recognition was significantly better than 1-bit recognition. In six of the eight documents, 3D OCR recognition was acceptable (as compared to only 1.5 of the 1-bit scans).

Our additional testing shows that while 3D OCR scanning may be a slight improvement for many business documents, the improvement is so tiny that it may not be noticeable. But 3D OCR does make recognition possible for a new class of documents. Since most of these documents require manual zoning, one could argue that Caere should not have made 3D OCR the default. But setting it as the default means one less decision that the user has to make without exacting much of a penalty.

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Together, We're a Genius

Charlie and I met in fifth grade, when his family moved to our neighborhood. We hit it off right away and went through adolescence and young adulthood together—enjoying school activities, fixing cars, and braving the mysteries of girls and dating. We went

to different colleges but occasionally visited one another's campus. Leaving the student commons on a particular day, we saw one of the first electronic quiz machines in the lobby. We looked at each other and invested a quarter, more intrigued by the machine and its inner workings than desirous of testing our IQs.

The questions were structured somewhat like "Jeopardy" categories but with multiple-choice answers. We breezed through the easier levels, racking up bonus round after bonus round. The machine let you play until you couldn't earn enough points to go to the next round and then told you your supposed IQ level. Things got more interesting as the questions got more esoteric. A question stumped me. Charlie hit the button next to "Carthage." He stared blankly at the next question, while I punched the "Henrik Ibsen" button without hesitation.

"How'd you know that?" he asked.

"I dunno. Must've covered it somewhere."

And so it went, through the sciences, the humanities, mathematics, and history. By this time, a small crowd had gathered, watching us hit buttons and rack up scores, calling out encouragement. But Charlie and I were amazed at what each of us knew—and didn't know. Finally, the machine had no more questions for us. We'd achieved the top score, the "Genius" light flashed merrily, and the others cheered, then pushed forward eagerly to try their hands.

Charlie had a wonderful way of putting things succinctly. "How about that?" he said. "Together, we're a genius."

I've had the group-genius experience a number of times in the intervening years when the whole of some group has proved greater than the sum of its parts. Lately, I've had that experience in some Internet newsgroups. I used to dislike newsgroups because of the spam and flames. I preferred CompuServe forums, since they were moderated and you needed more than a modem to get in the door.

Forums and newsgroups let people with a common interest, however esoteric, share information. Unfortunately, the door is open to anyone, and no newsgroup is im-

mune from the cyber-graffitists who stop by to stir up the troops or ridicule their common interest. Such messages are deleted quickly in moderated forums but get propagated in newsgroups as people rise to the bait.

I still think CompuServe's forums are great, but newsgroups have made enormous strides in the past 18 months. Much of the credit goes to sophisticated antispam software, such as militant cancelbots that delete cross-posted messages. Some even look at the content of each message and score it for appropriateness to the newsgroup. There are moderated newsgroups, but the vast majority are unmediated, with only cancelbots and the agreement of subscribers to keep things under control.

Spamming newsgroups slows down the newsfeed and clogs the Internet with garbage. People who respond to spam that gets past the cancelbots worsen the situation, as their messages are propagated among all the other news servers. But nothing is as damaging to the group genius as flames, especially to regulars in a group. Protected by a heavy layer of software and physical distance, people degenerate all too easily into obscenity and personal attacks.

One lawyer I used to respect caused the demise of a CompuServe forum, because he perceived an insult from another member and threatened to sue CIS, the forum owners, and the sysops. I resolved, as did others, never to respond to another of his messages on any forum.

Shunning isn't a nice thing to do to people, but the good of the group—and the care and feeding of the group genius—is more important than a hypersensitive individual with a quick trigger finger. As with spam, the best thing to do with offensive messages or individuals is just ignore them.

You can learn more about antispam efforts at www.zdnet.com/pccomp/interdot/idot297 or check with your ISP, which probably has a spam-information page. For example, try www.earthlink.net/spam or www.headlines.yahoo.com/Full_Coverage/Tech/Spam_Wars. For a look behind the scenes, try the news.admin.net-abuse newsgroups.

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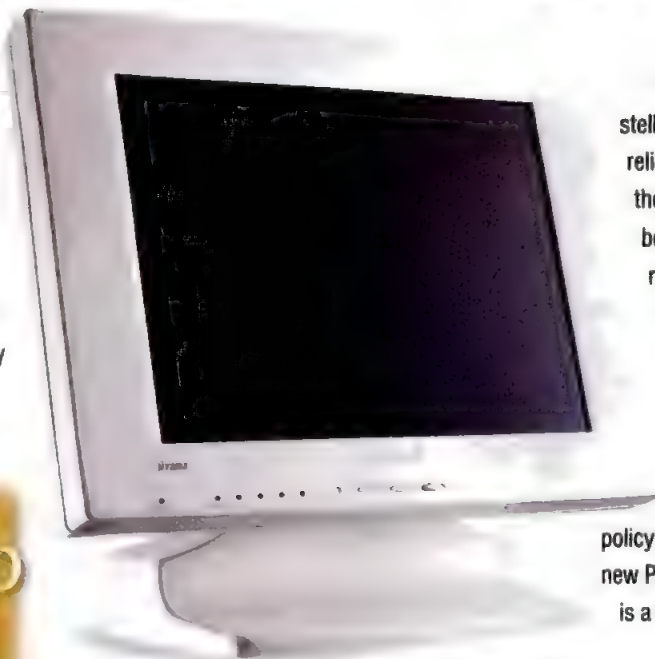


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I Have Seen the Future

I do a lot of public speaking, and over the last few years I've noticed that the newer LCD projectors have been replacing those funky Sony three-lens monstrosities that were always an operational nightmare. I now believe these units will eventually

replace home TVs, too.

Some years ago, when video projectors were first on the market with 640-by-480 resolution (or worse) and weak lamps, it was not so obvious that such a device might become the "TV on the wall" that has been predicted for decades. The colors were not good, the images were not as sharp as they could be, and the little LCD building blocks within the images were clearly visible and annoying.

Since then, developers have gone to three converged screens, each with a typical resolution of 800-by-600, which is far better than a standard TV or an old-fashioned video-beam projector. The model I have is a ViewSonic VPRJ-21408. ViewSonic is an extremely aggressive company that tries to push prices lower. So when ViewSonic started making this kind of projector, I knew something would happen, and I got interested fast.

The VPRJ is an outstanding example of the new small-form-factor genre. This 400-lumen, 800-by-600 model with a 300-foot image potential costs less than \$5,000. It accepts most international video signals, including NTSC variations, PAL, and SECAM, as well as VGA/RGB, S-video, and Mac signals. It weighs about 14 pounds and is small enough to fit in a suitcase. An added feature, which I've not seen elsewhere, is a PCMCIA slot with built-in processing power. You can project a slide show, for example, from the PCMCIA card alone, with no PC needed.

The new projectors are perfect for small venues. What's amazing is the new internal circuits that make hooking up these things effortless. I was recently at an event where three other speakers all needed to plug their individual laptops into the LCD projector. One after the other, the unit properly recognized the signals and delivered the images. Years ago when you had any variation in one of those monstrous video-beam clunkers, a technician had to spend hours making adjustments. It was ludicrous. But besides being great PowerPoint projectors, the new units can be used for plain TV. Here's a convergence issue with a new wrinkle: "Honey, I'm off to Atlanta to give a speech, and I'm taking the TV with me!" Sharing may become a real problem, and

I believe families will have two or three of these at home.

I decided to hook the VPRJ up to a small VCR and project a movie here and there around the house. It was obvious to me in just a few minutes that such boxes will become the TV of the future—the flat TV on the wall. Point them against any white wall and they easily project and focus images that cover the wall. I put up a 6-foot-high image in my office and found looking at it much more satisfying than watching the tube. The image is big and sharp and doesn't seem to cause eyestrain. The projectors are typically less expensive than large wall-hanging plasma displays, and they're much more versatile. In fact, the idea of the TV set (plasma or otherwise) that you hang on a wall will never happen. Here are the advantages of a projector, compared with a flat-panel TV:

Portability A projector can be easily moved from room to room without danger of breaking the device. A large flat panel of any technology is like a framed piece of breakable glass.

Variable-size image You can't change the image size of a flat panel. Also, the projectors can switch between the newer 16:9 aspect ratio and the 4:3 ratio automatically.

Travel size The unit I have even has a European power cable, so you can plug it into a 220V socket in Paris.

There are a few disadvantages: The best projectors are dangerously bright, and you can easily look into the bright

light by accident. When the bulb burns out, it needs an expensive replacement (around \$300 for a typical 150-watt DC-metal bulb). Fortunately, the bulbs work for over 1,000 hours, and I've seen one advertised to work for 4,000. A lesser disadvantage is the need to view the image in a darkened room, which may change as technologies improve.

Although \$5,000 or even \$3,000 is too much to pay for a typical home TV, I see no reason why this technology shouldn't follow the pattern of dropping prices common to all high technology. Watch the market pop when a \$1,999 unit is introduced in the years ahead, and then watch it explode at \$999.



LCD PROJECTORS

It's obvious that such boxes will become the TV of the future—the flat TV on the wall.

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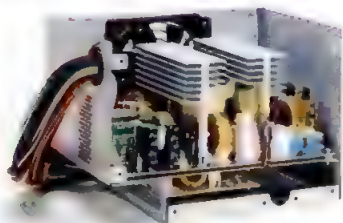
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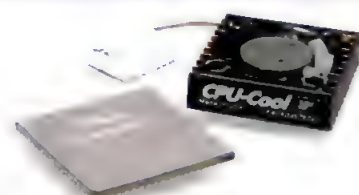
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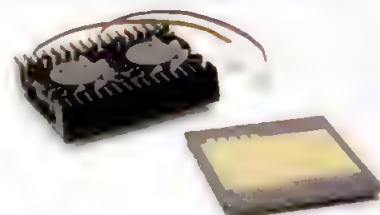
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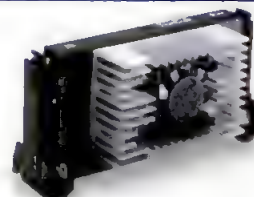
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Inside Track

The irony of ironies in the chip business is the worsening economic situation in Asia. The dollar has become so strong that Asian countries can no longer afford to buy anything from us, and that includes various gear involved in the chip fabrication process. A recent conference in New York called SEM-Invest outlined the predicament.

The most obvious example of this problem is that of the **Korean memory makers**. Because of Korea's weak currency, memory prices should **fall through the floor**, allowing the Koreans to capture the market, if they could just ramp up capacity. But capacity costs money, which they haven't got. It's a **catch-22**. Worse, most of Asia has put plans to build new fabs on hold until the economies stabilize. According to one report, at least **20 new fabrication plants**—most of them to make 300-mm products—are in limbo. This is an enormous number of chips that will not be coming on-stream when they should. Since these things are planned so far in advance, it means that once more we'll see some sort of **shortage situation**, probably around 2000. **followed by a glut**, numerous bankruptcies, and lots of complaining. Gee, what else is new?

This cycle of shortage, glut, shortage, glut is the most serious problem the industry faces. No matter how well they plan around this cycle, there is always something that crops up (such as the Asian financial crises) to keep the cycle alive. Intel, meanwhile, has finally bitten the bullet on the 300-mm revolution with a \$1.5 billion facility in Hillsboro, Oregon, that is supposed to make 0.13-micron products—a process unperfected. Some analysts at the SEM-Invest conference took a **contrarian view** of these delays, citing profitability problems during the transition to 200-mm technologies. Their thinking is that the longer it takes, the smoother the transition. In fact, the potential for a shortage and a slower advancement might well make these companies more money, not unlike the profits that were made during the **oil shortages of the 1970s**. Whatever the case, we can assume that none of this will benefit the memory-hungry consumer. As more memory-intensive applications begin to appear **and we find we need 128MB to 256MB of main memory** on our desktops, we'll start to see prices go up again. It's estimated that 17 of the 20 fabs that were put on hold were going to be for memory chips.

Executive Follies Dept.: Did you see that wild exchange of news stories about Gates, Barksdale, and McNealy being asked to testify before Congress? Gates said no, so Barksdale said no because Gates said no. Then Gates said yes, so everyone will testify. I'm reminded of a recent conference where Gates and Ellison were going to debate,

An enormous number of chips will not be coming on-stream when they should. We'll see some sort of shortage situation, probably around 2000, followed by a glut, numerous bankruptcies, and lots of complaining.

then Gates said he'd send Ballmer or someone else, and Ellison said he wouldn't do it if Gates wasn't there. Does anyone sense a **lot of ego problems** in this business? It seems to me that if these guys were serious about scoring points with an audience, they'd prefer to duel against a second-stringer. And Barksdale should have relished the idea that he could rant to Congress while Bill sent a minion, which would appear contemptuous from the get-go. **No wonder Bill wins every time.**

Acronym of the Week Dept.:

The daily introduction of new acronyms is enough to drive us all crazy, especially since most of them fade into oblivion within months. But here's one that may stick: PAN, the Personal Area Network. GTE is promoting the term with the introduction of a new 900-MHz RF network with a 30-Kbps speed and **9-foot range**. Yes, Bunky, this is the specification. The use for this technology is—uh, well . . . printers? I'm glad these big phone companies are finding new ways to spend money. Hmm, maybe this PAN acronym is nonstick.

While on the Subject of Nonstick Dept.: I see AMD is now getting into the ADSL game by making chips using the Alcatel technology, which allows a maximum speed of 8 Mbps. This technology is never going to fly, because the phone companies don't want to give people high-speed access, period. It would allow us to transition to IP telephony and kill their long-distance business. So as Donnie Brasco said, "Forget about it."

More likely to continue is our miserable link via modem, especially now that we have V.90. Those of you who have put off going to 33.6 or 56K or whatever should wait no longer. The new V.90 modems have standardized all the competing 56K protocols. Note that although V.90 is now shipping, there is **one more final fix** involved in the standard. There's a period when the standards-governing body finds a flaw or two and tweaks it. This change should take place before the end of the year. But all the V.90 modems being sold today are **field-upgradable**, so you just go to the modem company's Web site and load a patch to upgrade the modem to the final standard. 3Com has quickly brought out a V.90 modem that's backward-compatible with its old 56K modems. So you can still dial up those X2 ISPs and get faster speeds. Buyers of older 56K technology should note that their modems are probably upgradable, too. Few people take advantage of how easy it is to upgrade a modern modem.

As before, though, the likelihood of actually achieving 56K is remote. Look for **typical throughput of 40K to 46K** from the downlink. Speeds like this are still nothing to sneeze at. **PC**

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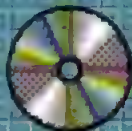
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Digital Cameras: Reality vs. Hype

Too often the gap between the promise and the reality of new toys for PCs grows even faster than PC feature lists do. People spend good money for peripherals and accessories not yet ready for the serious purposes buyers have in mind when they make their

purchases. And inevitably a backlash sets in: If a tool that is supposed to do everything from A to Z serves only from A to maybe J, unhappy buyers decide the whole idea is a scam, and the real usefulness of these new gizmos is soon overlooked or forgotten.

I think something like that is happening right now with digital cameras. According to what I hear, both from friends and acquaintances and from readers of *PC Magazine* (as reflected in the contents of my mailbox), a lot of first-time buyers of digital cameras are unhappy with their new toys. Sure, they're whizzy devices, the complaint goes, and a lot of fun to use, but the pictures they turn out are—umm—not very good. And they're way, way short of the kind of pictures most of us are used to getting from 35-mm cameras.

That call isn't far off. If you compare the output from the best of today's sub-\$1,000 digital cameras, printed on the best of today's photo-grade ink jet printers, with glossy 4-by-6 prints from film run through your \$200 35-mm SLR and processed in the nearest 1-hour photo lab, you're going to be sorely disappointed.

You're also missing the point.

Though many vendors sell them as replacements for film cameras, digital cameras simply aren't good replacements for film cameras at present. They have different strengths, and digital cameras are very good at serving purposes that are, by contrast, very poorly served by traditional film-based photography.

But the two technologies simply aren't the same thing, and confusing them is a guaranteed road to disappointment.

Moreover, since there's about a 10:1 ratio between the prices of roughly comparable digital and film cameras, falling for hype and overstatement can cost you a bundle.

So who should buy a digital camera? What are they good for? I use digital cameras often, and love 'em: They're a joy for quick photos for Web pages, for snapshots to attach to e-mail messages, for "prescanned" photos to drop into laser-printed reports, and for last-minute snapshots I put in PowerPoint shows. In other words, for almost every application where I'm going to use the finished photos in

nontraditional—that is, nonphotographic—media.

And yet they're really lousy for landscapes, portraits, sports pictures, and any other kind of photography where a print is the ultimate and highest use of the picture. Even with expensive glossy photo-printing paper, 4-by-6s from digital cameras and ink jet printers aren't nearly as satisfying as traditional 40-cent 4-by-6s from photofinishers. With every generation of new digital cameras and printers, that gap is closing a little more—but it still exists, and the difference isn't trivial.

In our family, folks are really into swapping digital photos, either as attachments to e-mail notes or by posting them on family Web pages. Nothing comes close to the speed, ease, and convenience of a digital camera for this kind of task. Even low-end digital cameras work fine for these informal family snapshots. This is a social activity, not fine-art photography. People want to see Aunt Sue's big grin at the Christmas party, not Ansel Adams's Zone System.

For more demanding uses, such as photos for PowerPoint shows and consulting reports, you really need the higher-quality images produced by the \$650 to \$1,000 digital cameras, such as Olympus America's exemplary D-320L and D-600L or Eastman Kodak's DS DC210.

But when we want prints—not necessarily 8-by-10s or 16-by-20s, where digital cameras are truly hopeless, but just a stack of 3-by-5s or 4-by-6s to pass around and

mail to far-flung friends and relatives—we grab a traditional 35-mm point-and-shoot or SLR. Even with fast, relatively grainy film, such as Kodak's Max, the final image quality on paper from a \$75 point-and-shoot or a \$200 SLR outpaces that delivered by a digital box costing several times as much.

Moreover, most people value conventional film prints more highly than ink jet prints. There's almost always a reaction of "What's this?" to a computer-printed image given as a print. That will change with time—at about the same rate as the quality of those computer-printed snapshots improves—but today it's always there.

Whether this matters to you depends a lot on your



DIGITAL VS. 35-MM

Confusing the purpose of the two technologies is a guaranteed road to disappointment.

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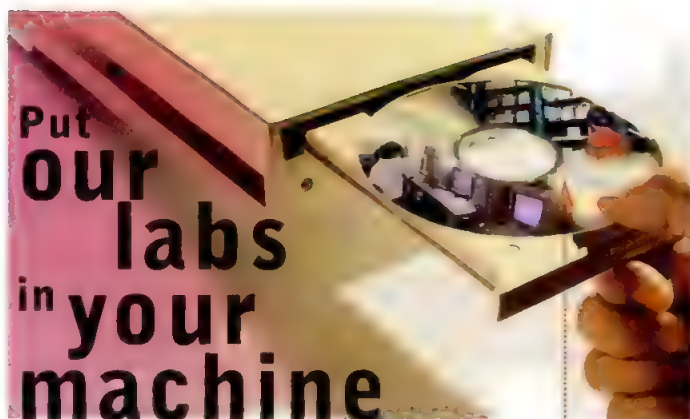
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JIM SEYMOUR

expectations for photos and probably on your age as well. If you live the Web lifestyle, communicating mainly through e-mail and via your Web page, then the quality of prints in-hand is meaningless: You live by electronic images. Go buy a digital camera today, if you haven't already.

But if you're a traditional snapshooter who's been eyeing the falling prices and increasing quality of digital cameras and photo-quality ink jet printers, and if you're wondering whether it's time to replace your Canon or Minolta 35-mm with an Epson or Hewlett-Packard digital camera, think twice—and twice again—before making the leap. You may well regret your purchase.

Beyond absolute image quality and print quality, there are three more issues to consider in deciding between digital and film imaging. All three of these are claimed as big wins by the digital side, but the digital advantage for each category is, I think, small.

The first claim is immediacy: You get the digital images right away. When we have 30-minute photo labs on every corner, I think that's almost a nonissue. Except for those uses where digital cameras are already the clear choice, processing time isn't a big factor.

The second assumed digital advantage is the ability to manipulate images easily in a computer—the modern-day equivalent of the home darkroom of the fifties and sixties. I like fooling around with digital images too, but I've found very few owners of digital cameras who really sit down and fiddle with the color, brightness, and sharpness settings of their digital photos. Just as home darkrooms themselves have almost disappeared from the scene in our increasingly hectic and decreasingly hobby-oriented culture, tweaking your digital snapshots in Adobe PhotoDeluxe or Microsoft Picture It! just isn't a big deal.

Finally, there are the claims for the economy of digital snapshots: no film, no processing. Yes—as far as that goes. But for the several hundred dollars in additional cost for a digital camera over a comparable film unit, you could buy a lot of film and prints. I suspect that very few digital camera owners will ever recoup that additional capital investment through savings in film and photo lab charges.

In the end, it comes down to this: Both digital and film cameras have their advantages and their uses. Go digital for the wrong reasons and you'll be a very unhappy picture taker; stay in film for the wrong reasons and you'll be equally unhappy. **PC**

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The Perfect Low-Cost Laptop Bag

Engineering a great \$100,000 car isn't so hard, the saying goes, but it takes real talent to create a good \$15,000 car. The same thing goes for buying laptop bags. If you've got \$300 to spend, you can find some breathtakingly good-looking, highly protective, functional

bags. It's harder when you want to spend only \$75.

Last issue, I wrote about high-end bags. My favorites included bags from Hartman, Port, Tenba, and Tumi. This issue, I'll cover bags that for the most part sell for less than \$100. At that price, the bags aren't as supple, they don't offer sophisticated cradles for your computer, and I suspect they won't last as long—even the ones with limited lifetime warranties. Three times in the nineties I've had a snap or buckle give way when I was sprinting to catch a plane or a train with a loaded bag, and each time it was with a sub-\$100 bag.

As a group, these bags are sporty and youthful-looking (as opposed to businesslike), especially the canvas or Cordura nylon bags. Some of the imitation-leather bags do a fair job of passing for real leather. Here's my take on affordable bags selling, for the most part, for \$100 or less.

Best convertible backpack bag, most intriguing bag overall. The Kensington SaddleBag (\$90 street, 800-535-4242, www.kensington.com). This 16-by-14-by-9-inch bag (HWD) doesn't look like a computer bag (a plus if you're worried about theft) and can be carried three ways: by a removable shoulder strap, by hideaway backpack straps, or with the handle. Several of the inside pockets are covered in see-through mesh, which makes it easier to locate loose objects.

Best traditional shoulder bag. Take your pick. Of the dozen I tested, none leapt out and said, "Keep me." The Kensington Sky Runner (\$80 street) had the look of high-end ballistic nylon but felt stiff. CaseLogic's Koskin bags (800-447-4848, www.casellogic.com) are passable leather knockoffs, though you won't mistake them for \$500 Coach bags. Ditto for vinyl bags from industry leader Targus (714-523-5429, www.targus.com). If you want a sporty look, you'll like the construction of the nylon Cordura bags from L. L. Bean (800-221-4221, www.llbean.com) and Eagle Creek (619-471-7600, www.eaglecreek.com). The Lands' End Square Rigger Deluxe Laptop Attache (in canvas, \$129.50 direct; in ballistic nylon, \$139.50; 800-963-4816, www.landsend.com) is very well built, but at 14 by 18 by 7 inches the height is wasted and

just makes the bag look and feel too bulky.

Best backpack bag. Same story here: Lots of good choices, no standouts. The taller the bag, the more things will fall to the bottom and be unreachable. About half the bags I saw had cinch straps that go around your waist and unless you're mountain climbing with your computer, those straps just dangle and get in the way; you'll never use them.

Best second bag. The LeSportsac Satchel (\$80 street). This thin nylon bag has zero padding; it rolls down to next to nothing and goes in your garment bag for overnight trips. At a trade show, you can leave the heavy laptop bag in your hotel room and carry this onto the convention floor. Officially listed as 16 by 13 by 4.5 inches, it holds a lot more. Two complaints: The shoulder strap is slippery, and the LeSportsac name is annoyingly stitched five times across the front flap.

Dozens of other bags are available. A top-zipper bag is easier to open; a flap-over bag sheds rain better. A 16-by-12-inch or 17-by-13-inch bag will carry a newspaper unfolded; anything bigger starts to feel ungainly. Check for the number and location of pouches and pockets for sunglasses, wallets, disks, and so on. Look for double zippers so you can open compartments from both ends, slit pockets for travel documents, an umbrella strap, and a pager loop. If you walk a lot with your bag, check for one with convertible backpack straps. If you wear a wool winter coat, check that the bag

isn't so coarse that it abrades the coat (this can happen). For fuller summaries of these and other bags, check out an expanded version of this column at ZDNet's Notebook User Site (www.notebookuser.com).

Also: Consider getting small bags (\$5 to \$20) for odds and ends you can stuff in and pull out readily (mesh fronts help). Lands' End makes a handy leather handle wrap (catalog number 2842-4A77, \$12.50 direct) to hold together the two carrying handles on most bags. And at least a dozen vendors make padded laptop sleeves (\$20 and up) that provide a little more protection for some less padded computer bags. **PC**



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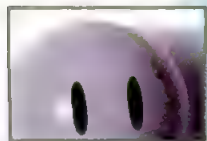
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NEW, NEAT, & NIFTY

Logitech TrackMan Marble FX Page 104



Hot Technology For users on the leading edge, these are the most intriguing accessories: palmtops, Web hardware, and communications. **102**



Input Devices They've built a better mouse—not to mention keyboard—and we have them here: mice, trackballs, touch pads, and such. **104**



Imaging Peripherals Need to grab an image from paper or for the Web? There's a device for you: scanners, Web cameras, and more. **106**



Multimedia Tools Add the best video and audio components to your workaday PC: speakers, video capture devices, and TV tuners. **110**



Travel Arsenal Life on the road is hard enough. Let these products make it easier: portable peripherals, communication aids and bags. **112**



Presentation Hardware Let your hard work be seen and heard in any conference room. Remotes, speakers, and scan converters. **116**



Gamer Gear When work is done, the gamers come out to play. Here are the hottest accoutrements: sticks, game pads, and controllers. **120**



Ergonomic Aids These improvements on everyday office fixtures will help you work more comfortably: input devices, fixtures, and more. **124**



Kids' Stuff Get the little ones hooked on computing with hardware designed just for them: input devices, PC desks, and Barney. **128**

Photography by Jeffrey Krein

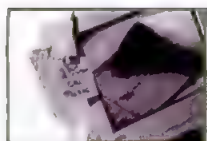
TRIAL HARDWARE

you think you have everything you need to make your PC complete, think again. Beyond the basics of a monitor and printer lies a universe of accessories that will help you work smarter, faster, and better. We've tested scores of products—from palmtops to speakers, from input devices to UPSs—to identify the 130 gadgets we like best. Most are affordable; a few will have you breaking open that piggy-bank, but they're worth the price.

Nokia 9000i Communicator Page 103

HARDWARE HITS ONLINE

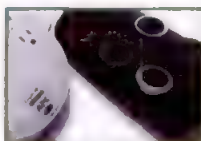
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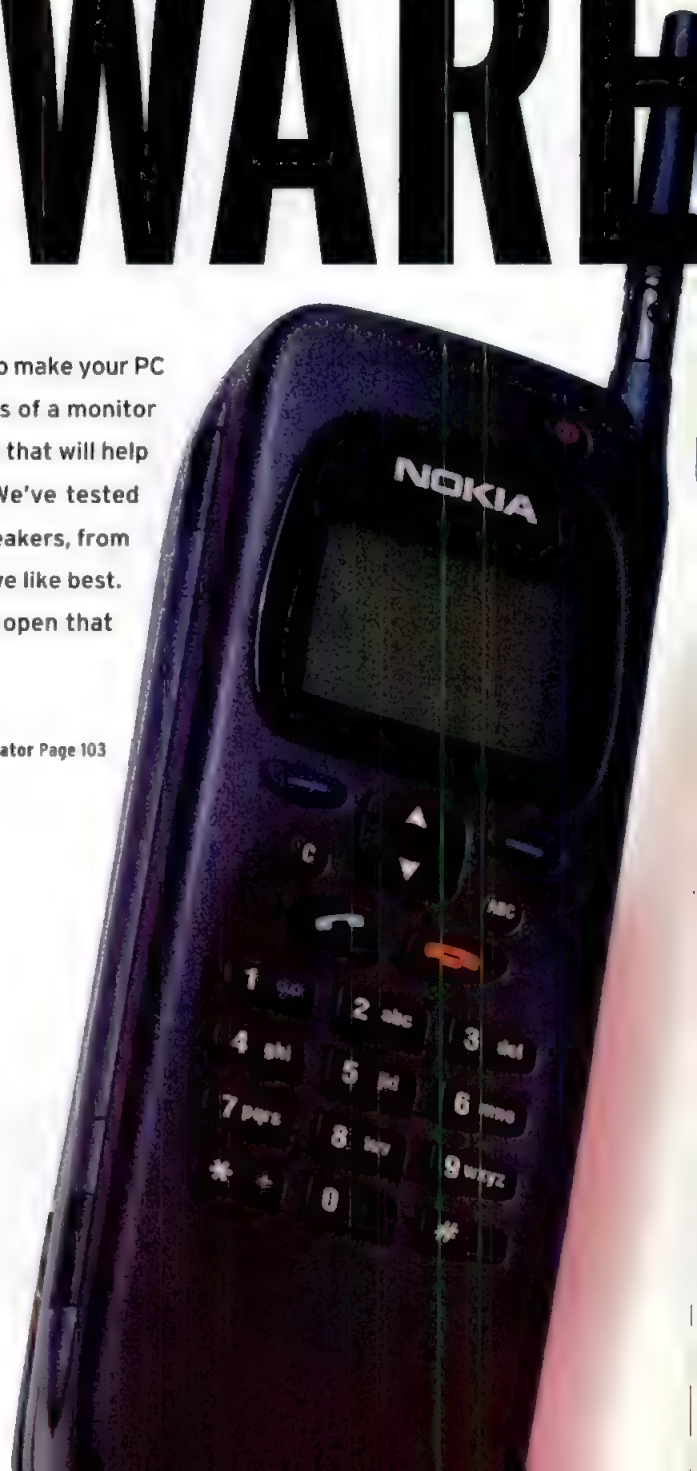
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PC Cards That slot in your laptop can open a world of functionality. Here are a half dozen of the most useful PC Cards available.



Power Protection Protect your equipment from spikes and keep your PC running in a blackout: UPSs and surge suppressors.



HQ TECHNOLOGY

From palmtops to Web gadgets, these are some of the most intriguing hardware accessories.



Franklin REX 3-DS We liked the REX 3-DS (\$180 street) from Franklin Electronic Publishers from the moment we started using it. Effectively a palmtop PC in PC Card format, the Rex lets you download a wide range of PIM information directly from your PC (in read only format). You can also use the built-in software as an address book, calendar, to-do list, and memo pad. **Franklin Electronic Publishers Inc.**, Burlington, NJ; 888-739-6400; www.franklin.com (ORS 559).

Homes of the Future Thanks to clever scheduling software and X-10 remote-control technology, which uses the electrical wiring in your walls to transmit commands, you can now use your PC to turn on lights, appliances, climate-control equipment and more automatically. Two products we like are **Active Home Automation System** (\$100 street) from X-10 USA and the similar IBM's **Home Director** (\$100 street). The basic packages from each company include the software, PC connection, and three control modules; additional modules are \$15 to \$25. **IBM Corp.**, Research Triangle Park, NC; 800-426-7335 ext 4340; www.pc.ibm.com (ORS 567). **X-10 (USA) Inc.**, Closter, NJ; 800-675-3044; www.x10.com (ORS 623).

Northstar USB HubSTAR This year should be the year USB, the Universal Serial Bus, lives up to its promise. This expansion bus lets users easily connect four, eight, or more low-bandwidth devices (keyboards, mice, page scanners, digital cameras). Most PCs shipped in the past 18 months have a single USB connector on the back, and some monitor and keyboard makers are making devices with several ports to serve as a hub. But if you don't want to invest in a new monitor, a more practical solution is a standalone USB hub, like the USB HubSTAR (\$99 list) from Northstar. The unit gives you four easily accessible USB ports right on your desktop. **Northstar Systems Inc.**, Rancho Cucamonga, CA; 909-483-9900; www.northstarsystems.com (ORS 591).

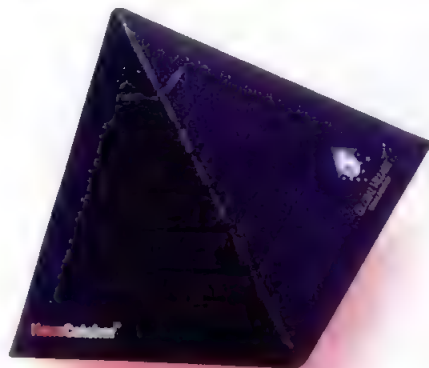
Psion Series 5 For robust functionality without carrying a notebook PC, the Psion Series 5 handheld computer (\$600 street) is the one to beat. The 12-ounce unit flips open to reveal a 2- by 5-inch monochrome touchscreen and miniature (but usable) QWERTY keyboard. It includes word processing, spreadsheet, and PIM applications, and more. **Psion Inc.**, Concord, MA; 800-997-7466; www.psion.com (ORS 534).

3Com PalmPilot Professional 3Com's PalmPilot Professional (\$299 list) is one of the best personal organizer systems on the market today. Its pen and touch-screen system does the job for memos and the like, and the 5.7-ounce unit fits neatly into your shirt pocket. The straightforward operating system gives quick access to your PIM data, e-mail gets you to crucial data quickly, and you can download thousands of extra functions from the Web. The new Palm III (\$399) delivers a bigger screen, more memory, and IR functionality. **3Com Corp.**, Mountain View, CA; 800-342-5877; <http://palm.pilot.3com.com> (ORS 521).

▼ AirMedia NewsCatcher

Internet Antenna If Web surfing and e-mail is tying up your phone line, take the wireless route with AirMedia's NewsCatcher Internet Antenna. This wireless receiver (\$79 direct) tunes into the AirMedia Live Internet Broadcast Network (\$5.95 a month), which delivers news feeds, e-mail, messaging, and a range of other proprietary content via your serial port. **AirMedia Inc.**, Newport Beach, CA; 800-247-6334; www.airmedia.com (ORS 526).

Infomaging 3D FaxPal Plus If you use your PC as your fax machine, the FaxPal Plus (\$169, list) from Infomaging will let you receive faxes while your PC is off. It stores up to 20 pages of data (expandable to 220), which it saves for you until you turn on your PC and retrieve the information with your own fax software. **Infomaging Technologies Inc.**, Pleasanton, CA; 800-966-2240; www.infomaging.com (ORS 568).



▲ American Biometric BioMouse

If you're concerned about strangers getting access to confidential files, you'll want the best security system available for your PC. The BioMetrics BioMouse (\$299 direct) desktop fingerprint scanner replaces password security with a fingerprint scanner that can't be hacked or circumvented by other users. For added safety, your fingerprint profile is stored remotely—not in the computer itself—and accessed over the Internet or a corporate network when you log in. **American Biometric Co.**, Ottawa, Ontario, Canada; 888-246-6687; www.biomouse.com (ORS 531).

◀ Nokia 9000i Communicator

Gadget lovers and businesspeople on the go will love this combination cellular phone, personal organizer, messaging terminal, and monochrome Web browser. The 14-ounce 9000i (\$850 to \$1000 street) allows you to read e-mail; send and receive faxes, maps, and other images; and transfer important information to your PC for safekeeping. **Nokia Inc.**, Dallas; 800-665-4228, www.nokia.com (ORS 590).

■ PC on your TV

Turn your living room into a digital arcade with AiTech International's wireless **PC/TV AirLink** (\$299 list) or the **Wireless PC@TV** (\$400 street) from RF-Link Technology. Just plug the transceiver into your PC, plug the radio receiver into your TV, and enjoy games, the Net, or any other computer functions on your TV—even if the PC is in another room. The rated distance is 100 feet, and the RF signal can carry through most walls, floors, and ceilings. **AiTech International**, Fremont, CA; 800-882-8184; www.aitech.com (ORS 528). **RF-Link Technology Inc.**, Torrance, CA; 888-273-5465; www.rflinktech.com (ORS 604).

▶ **WebTV Plus Receiver** The WebTV Plus Receiver (\$199.95 list) from WebTV Networks (also available from Philips, Sony, and others) works in conjunction with the WebTV Plus Network service (\$19.95 per month) to enhance TV viewing. You can access special online content while viewing your favorite TV programming or surf the Net, all from the comfort of your couch. **WebTV Networks Inc.**, Palo Alto, CA; 800-469-3288; www.webtv.com/ns/tune/homepage/plus.html (ORS 619)

■ **Intellogis Passport Network** If you have two PCs in the house and want to link them without getting Novell certification, consider the Passport Network (\$249.99 list) from Intellogis. The Passport uses your home's electrical wiring to connect your PCs for file sharing, printer sharing, multiplayer gaming, or using one Internet connection. There's no card to install, just simple wall plugs. One drawback: You'll have to choose between the Passport or an X-10 system, since the signals may interfere. **Intellogis Inc.**, American Fork, UT; 888-756-5199; www.intellogis.com (ORS 571).

WHEN MONEY'S NO OBJECT

AXIS 200 Web Camera For those looking for an easy way to put a live video image on the Internet, Axis Communications NetEye 200 (\$999 list) is a video camera equipped with an integrated Ethernet card and a built-in HTTP server. Installation is a snap—all you need to do is assign it an IP address and plug it into your network, and you're live for remote surveillance, traffic monitoring, or checking on your children at NetEye-equipped day-care centers. **Axis Communications Inc.**, Woburn, MA; 800-444-2947; www.axis.com (ORS 537)

Hughes DirecDuo Imagine blazing Internet access and digital satellite TV service all from a single dish, and you have the DirecDuo TV service all from a single dish. A satellite antenna brings in Internet access at up to 400 Kbps and over 200 channels of DirectTV and USSB programming. **Hughes Network Systems**, Germantown, MD; 800-347-3272, www.directduo.com (ORS 535)

INPUT DEVICES

They've built a better mouse—plus a better keyboard, trackball, touchpad, and tablet.

► **GF Productions Atmosphere Trackballs** If you're bored with the beige ball sitting in your trackball controller, replace it with something snazzier. GF Productions sells a variety of eye-catching replacement balls (\$14.94 direct)—Eyeball, Smiley Face, Yin-Yang—that fit Kensington and MicroSpeed devices. **GF Productions**, Long Beach, NY; 516-897-4049; www.gfproductions.com (ORS 560).

◀ **Microsoft Natural Keyboard Elite** The Natural Keyboard Elite (\$65 street) is the successor to Microsoft's popular split-design Natural Keyboard and is still one of the most comfortable on the market. The new model has the same number of keys (104), but it fits into standard-size keyboard trays for ergonomic loading under your desk. It's also USB-compatible and comes with its own USB adapter for eventual use in Windows 98. **Microsoft Corp.**, Redmond, WA; 800-426-9400; www.microsoft.com (ORS 583).

■ **PI Engineering Y-Mouse Dual PS/2 Mouse Adapter, Y-Key Key Dual Keyboard Adapter**

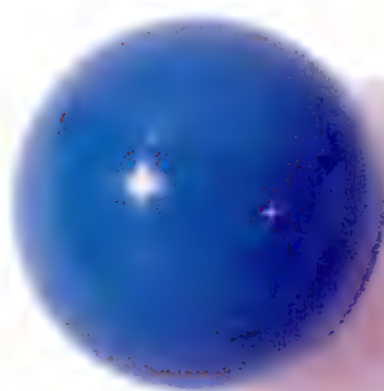
Sometimes you feel like a mouse; sometimes you don't. With PI Engineering's Y-Mouse Dual PS/2 Mouse Adapter (\$50 street), you can have a mouse and a trackball (or other input device) connected at the same time without hassle. The Y-Key Key Dual Keyboard Adapter (\$50 street) lets you connect two keyboards (a standard one for you and a specialized one for the kids, for example). **PI Engineering Inc.**, Williamston, MI; 800-628-3185; www.ymouse.com (ORS 599).

▲ **Twice-Better Touch Pads** The Cirque Power Cat (\$89 list) has it all. Scroll, surf forward and backward through the Internet, zoom in, and program almost every area of the Cirque Power Cat's surface individually. You can even sign documents with the provided Glide Pen. For a more straightforward touch pad that delivers precise control, there's the **EZ Pointe Touch Pad** (\$50 street) from PC Concepts. It does everything your mouse does with the touch of a finger. **Cirque Corp.**, Salt Lake City; 801-467-1100; www.cirque.com (ORS 548). **PC Concepts Inc.**, San Fernando, CA; 800-735-6071; www.pconcepts.com (ORS 597).

▲ **No-Cord Keyboards** If cable clutter is stealing more and more of your valuable desk space, have a look at Logitech's **Cordless Desktop** (\$100 street). A three-piece bundle that runs off radio-wave transmission, the Cordless Desktop consists of a wireless keyboard and a mouse, plus a transmitter that plugs into the back of your PC. Since it's not based on infrared signals, there's no line-of-sight obstruction problem. Just plug in the transmitter, put batteries in the keyboard and mouse, and start typing. We also like the higher-end **Wireless Surfboard** (\$399 list) from Wireless Computing, which delivers a 50-foot RF range with its keyboard and built-in touchpad. It's a good solution for controlling a conference-room PC from anywhere in the room, without wires. **Logitech Inc.**, Fremont, CA; 800-732-3039; www.logitech.com (ORS 579). **Wireless Computing**, Austin, TX; 512-263-8204; www.wireless-computing.com (ORS 621).



▲ **Logitech TrackMan Marble FX** Tired of mice that accumulate dust and gradually degrade in performance? You might be ready for a trackball. The sturdy TrackMan Marble FX (\$100 street) fits comfortably beneath your palm, and the ball sits between your index finger and thumb to provide precise control. Its patented laser technology detects the movement of dots on the surface of the ball that remain visible even if grease and dust accumulate. The driver has a full range of sensitivity controls, and the side buttons allow added programmable functionality. **Logitech Inc.**, Fremont, CA; 800-732-3039; www.logitech.com (ORS 579).



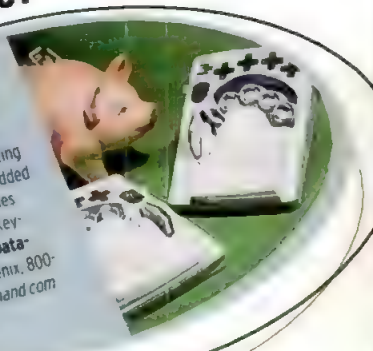
► Hunter Digital NoHands

Mouse This clever solution to the problem of repetitive wrist stress is as simple as it is radical: Use your feet! The NoHands Mouse (\$249.95 direct) consists of two interlinked foot pads that respond to slight pressure from your feet. One is for cursor control, the other for clicks; you can decide which foot does what. Like any mouse, it has sensitivity adjustments and connects into a standard serial or PS/2 mouse port. **Hunter Digital Ltd.**, Los Angeles, CA; 800-576-6873; www.footmouse.com (ORS 566)



WHEN MONEY'S NO OBJECT

DataHand Professional II With the DataHand Professional II (\$2100 list) typing is all in the fingers. Consisting of two contoured hand-pads embedded in a lap desk, the Professional II uses stationary fingertip buttons for keyboard and mouse functions. **DataHand Systems Inc.**, Phoenix, 800-875-7171, www.datahand.com (ORS 553)



◀ Kensington Picture This!

Mouse Pad The textured transparent top of the Picture This! Mouse Pad (\$13 street) allows for superior mousing and lets you see photos of your loved ones beneath. **Kensington Technology Group**, San Mateo, CA; 800-535-4242; www.kensington.com (ORS 574)



■ **3M Precise Mousing Surface** If you think all mouse pads are created equal, think again. The engineers at 3M have developed the 3M Precise Mousing Surface (\$17.78 list). The textured pad provides superior grip for your mouse's control ball, which means less wasted motion and more precise control for you. **3M Office Ergonomics**, St. Paul, MN; 800-332-7483, www.mmm.com (ORS 522)

▲ **Twice-Better Mice** We found two good reasons to replace your current mouse. Scrolling through documents is easier thanks to the **Microsoft IntelliMouse** (\$85 street). Ergonomically contoured, the IntelliMouse adds a scroll wheel between the left and right buttons that allows you to scroll up and down through Web pages, Microsoft Windows Explorer, and Microsoft Office 97 documents. The wheel also serves as a third button that aids in zoom functions and auto-scrolling. If you're a fan of the IBM TrackPoint cursor control on laptops, take a look at the **IBM ScrollPoint Mouse** (\$59.95 list). Built around the famous "red eraser" navigator, the ScrollPoint supports 360-degree fingertip scrolling—which makes navigation through Web pages and spreadsheets a snap and eliminates the need to use scroll bars. **Microsoft Corp.**, Redmond, WA; 800-426-9400; www.microsoft.com (ORS 583). **IBM Corp.**, Research Triangle Park, NC; 800-426-7235, ext. 4340; www.pc.ibm.com/us/ibmhome/scrollpoint/ (ORS 567)



▼ **Cross iPen** The Cross iPen (\$119.95 list) combines a special tablet surface with a synthetic-ruby pen tip to more closely simulate the pen-on-paper feel. Use it as a standard pointing device and as a tablet for signing and annotating electronic documents. **Cross Pen Computing Group**, Lincoln, RI; 800-510-9660; www.cross-pcg.com (ORS 552).

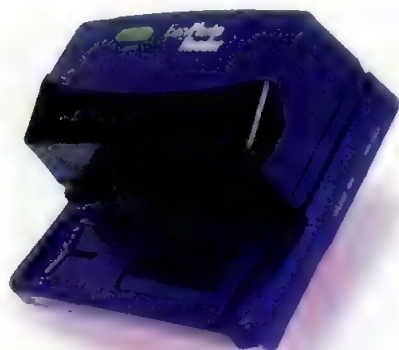


▲ **Kensington Orbit** A great feature of the Kensington Orbit trackball (\$60 street) is where they put the ball: right in the center. The Orbit is perfectly designed for anyone who has a variety of people using one PC: kids, adults and the oft-forgotten southpaw. **Kensington Technology Group**, San Mateo, CA; 800-535-4242; www.kensington.com (ORS 574)



IMAGING PERIPHERALS

Need to grab an image from paper or for the Web? There's a device for you.



▲ Storm EasyPhoto Reader

Storm Technology's snapshot-size EasyPhoto Reader (\$100 street) can bring your business or family photos into the digital age. The scanner has a resolution of 200 dpi (up to 1,200 dpi interpolated), and it saves images as standard 24-bit color JPEG files for use in e-mail, on the Web, and in electronic documents and presentations. Images look great, and Storm includes Adobe PhotoDeluxe for editing, an electronic photo-album maker, and more. **Storm Technology Inc.**, Mountain View, CA; 888-438-3279; www.stormtech.com (ORS 613).

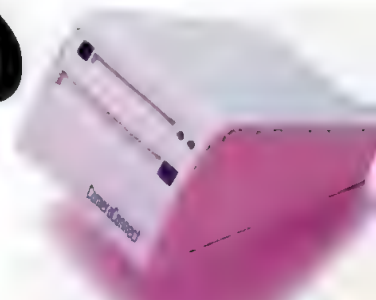
■ Intel Create & Share Camera Pack

The Intel Create & Share Camera Pack (USB, \$199 list; PCI, \$299) is an easy way to see and connect with family and friends. The kit contains a PC imaging camera, Video Phone software that allows you to make video phone calls just as you would telephone calls, and Create & Share software. You can use the software to access, organize, and manipulate saved images. **Intel Corp.**, Hillsboro, OR; 800-538-3373; www.intel.com (ORS 570).



▲ Visioneer PaperPort Strobe

For text-intensive scanning, consider one of the fine color page scanners on the market. The Visioneer PaperPort Strobe's (\$300 street) 300-dpi image quality and good software (Visioneer's PaperPort 5.0 for document management, and Xerox's TextBridge OCR package) make it an ideal tool for scanning and storing paper documents electronically. **Visioneer Inc.**, Fremont, CA; 800-787-7007; www.visioneer.com (ORS 618).



▲ ActionTec CameraConnect

Looking for a simple way to transfer digital camera pictures from your camera's memory card to your PC? ActionTec's CameraConnect (\$130 street) is the answer. Simply insert the CompactFlash or ATA Flash card into the appropriate slot, and you can retrieve files from and store files to the card. The reader connects easily to your parallel port and appears in Windows Explorer as a logical drive, so you can cut and paste files to your hard disk or open them with your own photo-editing software. **ActionTec Electronics Inc.**, Sunnyvale, CA; 800-797-7007; www.actiontec.com (ORS 523).



▲ **Corex CardScan Plus 300** The CardScan Plus 300 (\$280 street) scans business cards into a fully searchable and sortable database, so you can find contacts by first name, last name, company name, or any other detail you remember. The intelligent OCR software does a good job of recognizing what is a phone number and what is an e-mail address and placing them in the proper fields. It isn't perfect (you'll need to proof for missed characters), but it's faster than typing the cards in by hand. **Corex Technologies Corp.**, Cambridge, MA; 800-942-6739; www.cardscan.com (ORS 551).

▶ Panasonic EggCam

Panasonic's EggCam (\$129 list) is a tethered camera that captures full-motion color video at 30 frames per second, with a resolution of 320-by-240 dpi. It also includes a built-in microphone and speaker, so it's ready to videoconference as soon as you take it out of the box. And the easy-to-use software lets you create compact video e-mail that can be played by any Macintosh or Microsoft Windows user.

Panasonic Computer Peripheral Co., Secaucus, NJ; 800-742-8086; www.panasonic.com/alive (ORS 596)



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Performance**



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WOULD YOU BUY AGAIN?

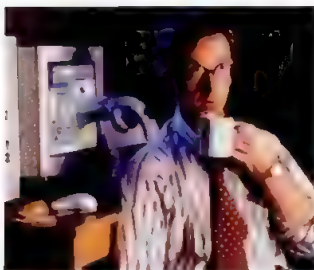
VENDOR	% WHO WOULD BUY THE SAME BRAND
Dell	92%
Quantex	91%
IBM	89%
Micron	81%
Gateway	80%
Acer	74%
Digital	69%
Toshiba	61%
Compaq	58%
Packard Bell	51%

OVERALL RANKINGS

Technical Support Survey

PC VENDOR	GRADE
Quantex	Excellent
Dell	
IBM	
Compaq	
Gateway 2000	Good
Micron	
Acer	
Toshiba	Fair
Digital	Poor
Packard Bell	

Windows Magazine, 4/97



QSentry Technology is like having a full-time tech expert in your Quantex PC, alerting you to possible hardware problems before they become critical.

We make it our business to come up with computing solutions for your business

If your business is looking for technology that can boost office efficiency and help you collaborate and communicate better, Quantex is your best bet. With rock-solid reliability built in, Quantex systems are designed to increase productivity, reduce downtime, and significantly lower the total cost of PC ownership for businesses of all sizes. Every business desktop and notebook we manufacture incorporates the most dependable technologies, ensuring our customers first-rate quality and performance. Combining the power of the Intel Pentium® II processor, the stability of Microsoft NT operating system, a host of quality components, as well as complete NT and Novell certification, our systems can guarantee your business results.

A technical support team that is one of the best in the business

At Quantex, we like to say that we've cornered the market on one aspect of providing the perfect PC often overlooked by other manufacturers. The proof is in a recent *Windows Magazine* survey which asked over 7500 PC users to rate their vendor's reliability, service, and technical support. The results put Quantex at the top with an overall ranking of "Excellent." For our customers, it's nice to know that choosing Quantex means more than receiving a great system.



QSentry Technology for an extra sense of security

An integrated collection of tools and utilities, this technology enables users to monitor the health of their Quantex PCs. QSentry provides real-time status on key operating conditions. It automatically detects potential hardware problems so hazards can be remedied before it's too late. In addition to coming pre-loaded with QSentry Technology, Quantex systems are compatible with industry standards and initiatives such as Wired for Management and DMI 2.0, making them easier to operate, configure and maintain.



Computer Shopper

1997 Direct Channel
Achievement Award
for Systems



PC Computing

1997 Most Valuable Product
QP6/266 SM-4x



PC Magazine

Editors' Choice Award
QP5/233 M-3 (12/97)



PC World

10 Best Buy Awards
Oct '97 - Feb '98



Business Desktops

Options: Zip 100MB Internal Drive w/one cartridge...\$79 • Business Audio Kit (Sound Card & Altac Lansing ACS-90 Speakers)...\$49 • HP LaserJet 6L Printer...\$379
• MS Natural Keyboard Elite...\$39 • APC Back-UPS 280...\$99 • APC Back-UPS 400...\$129 • APC Back-UPS 600...\$229

QP5/233 SB-1 \$1099

(with MMX™ Technology)

Business lease: \$39/Mo.

- 233MHz Pentium® Processor with MMX™ Technology
- 2 Universal Serial Bus (USB) Ports / DMI 2.0
- 32MB EDO Memory / 512KB Pipeline Burst Cache
- 2 1GB EIDE Mode 4 HD / 3.5" 1.44MB Floppy Drive
- 512B Neo 3D with 2MB SDRAM
- 15" Digital Monitor (13.8" viewable)
- Intel PRO 100 PCI Ethernet Adapter w/RJ-45
- 32X Max EIDE CD-ROM Drive
- Quantex Mid Tower Case
- 104-Key Keyboard with MS Mouse
- MS Windows 95 with MS Plus
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr/7-day Technical Support
- OSentry Technology (including Intel LANDesk Client Manager V.3.1)
- Upgrade to Windows NT Workstation 4.0 for \$59

Upgrade to 100MB Internal Zip Drive w/one cartridge
on all SB-Series Business Desktops for only \$79

QP6/233 SB-2 \$1599

(featuring Pentium® II processor)

Business lease: \$56/Mo.

- 233MHz Pentium® II Processor
- 2 Universal Serial Bus (USB) Ports / DMI 2.0
- 32MB SDRAM Memory / 512KB Secondary Cache
- 4 3GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- 64-bit 3D AGP Graphics Card with 4MB SGRAM
- 17" Digital Monitor (15.8" viewable)
- Choice of Intel PRO 100 Ethernet Controller with Wake-On-LAN™ Technology or K56flex protocol Fax/Modem*
- 32X Max EIDE CD-ROM Drive
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95 with MS Plus
- MS Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr/7-day Technical Support
- OSentry Technology (including Intel LANDesk Client Manager V.3.1)
- Upgrade to Windows NT Workstation 4.0 for \$59

QP5/233 SB-2 (with MMX™ Technology)...\$1399

QP6/266 SB-2 (w/ Pentium® II Processor)...\$1699

QP6/266 SB-3 \$1899

(featuring Pentium® II processor)

Business lease: \$67/Mo.

- 266MHz Pentium® II Processor
- Intel 440LX PCI Chipset / DMI 2.0
- 2 Universal Serial Bus (USB) Ports
- 64MB SDRAM Memory / 512KB Secondary Cache
- 6 4GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- 64-bit 3D AGP Graphics Card with 4MB SGRAM
- 17" Digital Monitor (15.8" viewable)
- Choice of Intel PRO 100 Ethernet Controller with Wake-On-LAN™ Technology or K56flex protocol Fax/Modem*
- 32X Max EIDE CD-ROM Drive
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows NT 4.0 Workstation
- MS Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr/7-day Technical Support
- OSentry Technology (including Intel LANDesk Client Manager V.3.1)

QP6/300 SB-3 (w/ Pentium® II Processor)...\$2049

QP6/333 SB-3 (w/ Pentium® II Processor)...\$2149

QP6/333 SB-4 \$2399

(featuring Pentium® II processor)

Business lease: \$84/Mo.

- 333MHz Pentium® II Processor
- 2 Universal Serial Bus (USB) Ports / DMI 2.0
- 64MB SDRAM Memory / 512KB Secondary Cache
- 8 4GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- 3D Labs Permedia 2 AGP Graphics Card with 8MB
- 19" Digital Monitor (18.1" viewable)
- 32X Max EIDE CD-ROM Drive
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows NT 4.0 Workstation
- MS Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**
- 24-hr/7-day Technical Support
- OSentry Technology (including Intel LANDesk Client Manager V.3.1)
- Upgrade to Intel PRO 100 PCI Ethernet w/MOL* for \$69
- Upgrade to K56flex protocol Fax/Modem* for \$69

QP6/266 SB-4 (w/ Pentium® II Processor)...\$2149

QP6/300 SB-4 (w/ Pentium® II Processor)...\$2299

Microsoft Office 97

Small Business Edition includes: Word 97 • Excel 97 • Outlook 97 • Publisher 97 • Small Business Financial Manager 97 • Automap Streets Plus

Business Notebooks

Quantex H-1210 \$2199

(with MMX™ Technology)

Business lease: \$77/Mo.

- 200MHz Pentium® processor with MMX™ Technology
- Intel Mobile Module (133MHz) Architecture
- 12.1" SVGA Active Matrix Display
- 32MB SDRAM (expandable to 144MB)
- 512KB Pipelined Burst Cache
- 2GB HD / 3.5" 1.44MB Modular Floppy Drive
- PCMCIA K56flex protocol Fax/Modem*
- 20X Modular CD-ROM Drive
- PCI Bus with 128-bit graphics accelerator
- Integrated 16-bit Stereo Sound and Speakers
- Smart Lithium Ion Battery
- USB and Fast IR Ports
- Integrated Personal Touchpad
- MS Windows 95
- Corel Office Suite 8
- Carrying Case
- 24-hr/7-day Technical Support
- 3-year limited warranty on CPU and Main Memory
- 1-year parts and labor limited warranty on all other components
- Add a Deluxe Carrying Case for only \$39
- Add a PCMCIA NIC for only \$129
- Add a Mini-Docking Station for only \$169
- Add a 2nd Lithium Ion Battery for only \$189

H-1210 w/100MHz Pentium® processor
w/MMX™ Technology...\$2099

Quantex H-1331 \$3199

(with MMX™ Technology)

Business lease: \$104/Mo.

- 266MHz Pentium® processor with MMX™ Technology
- Intel Mobile Module (133MHz) Architecture
- 13.3" VGA Active Matrix Display
- 64MB SDRAM (expandable to 144MB)
- 512KB Pipelined Burst Cache
- 4GB HD / 3.5" 1.44MB Modular Floppy Drive
- PCMCIA K56flex protocol Fax/Modem*
- 24X Modular CD-ROM Drive
- PCI Bus with 128-bit graphics accelerator
- Integrated 16-bit Stereo Sound and Speakers
- Smart Lithium Ion Battery
- 7nd Lithium Ion Battery
- Mini-Docking Station
- USB and Fast IR Ports
- Integrated Personal Touchpad
- Windows NT Workstation 4.0 or MS Windows 95
- MS Office 97 Small Business Edition
- Carrying Case
- 24-hr/7-day Technical Support
- 3-year limited warranty on CPU and Main Memory
- 1-year parts and labor limited warranty on all other components
- Add a Deluxe Carrying Case for only \$39
- Add a PCMCIA NIC for only \$129

Power Multimedia Series

QP6/333 SM-4x \$2499

(featuring Pentium® II processor)

Business lease: \$88/Mo.

- 333MHz Pentium® II Processor
- 64MB SDRAM Memory / 512KB Secondary Cache
- 6 4GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- 3D Labs Permedia 2 AGP Graphics Card with 8MB
- 19" Digital Monitor (18.1" viewable)
- K56flex protocol Fax/Modem* w/Voice Mail and Speakerphone
- 32X Max EIDE CD-ROM Drive
- Ensoniq 32-Bit WaveTable Sound Card
- Altac Lansing ACS-90 Speakers with ACS-250 subwoofer
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95 with MS Plus!
- Power Multimedia Software Bundle
- Microsoft Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**

QP6/266 SM-4x (w/ Pentium® II Processor)...\$2299

QP6/300 SM-4x (w/ Pentium® II Processor)...\$2449

QP6/333 SM-4x SE \$2599

(featuring Pentium® II processor)

Business lease: \$91/Mo.

- 333MHz Pentium® II Processor
- 64MB SDRAM Memory / 512KB Secondary Cache
- 8 4GB Ultra ATA HD / 3.5" 1.44MB Floppy Drive
- 3D Labs Permedia 2 AGP Graphics Card with 8MB SDRAM
- 19" Digital Monitor (18.1" viewable)
- K56flex protocol Fax/Modem* w/Voice Mail and Speakerphone
- Toshiba 2nd Gen DVD-ROM Drive w/DVD Decoder Board
- Ensoniq 32-Bit WaveTable Sound Card
- Altac Lansing ACS-490 Speakers with subwoofer
- Quantex ATX Mid Tower Case
- 104-Key Keyboard with MS IntelliMouse
- MS Windows 95 with MS Plus!
- Power Multimedia Software Bundle
- Microsoft Office 97 Small Business Edition
- 3-year limited warranty with 1-year On-Site Service**

QP6/266 SM-4x SE (w/ Pentium® II Processor)...\$2399

QP6/300 SM-4x SE (w/ Pentium® II Processor)...\$2549

Power Multimedia Software: • MS Money '97 • Office Mate • Day Planner Pro • Power Business Plans • Form Designer
• Project Manager Pro • Labels Unlimited • Compton's Reference Collection • Dr. Solomon's Find-Virus • MS Internet Explorer 4.0

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MULTIMEDIA TOOLS

Add the best audio and video components to your PC.



▲ **Cambridge SoundWorks** Among the best (and most compact) upgrade speakers we've found are the three-piece SoundWorks (\$149 direct) from Cambridge SoundWorks. The set matches compact cube-shaped satellite speakers with a powerful subwoofer and delivers the most lifelike music reproduction we've heard in the price range. **Cambridge SoundWorks**, Newton, MA; 800-367-4434; www.hifi.com (ORS 544).

■ **Boston Acoustics Media Theatre** The Boston Acoustics Media Theater (\$199 list) also mates tiny cube-shaped satellite speakers with an impressive subwoofer. We found these speakers to have more bass punch than the SoundWorks, which many listeners prefer. **Boston Acoustics Inc.**, Peabody, MA; 978-538-5000; www2.bostonacoustics.com (ORS 541).

■ **Labtec LCS-1022, LCS-2408** For those on a tighter budget, Labtec's two-piece LCS-1022 Space-Saver speaker system (\$50 street) delivers impressive sound quality. You can add the LCS-2408 Universal Subwoofer (\$50) as budget allows, and the subwoofer can be used with any two-piece PC speakers. **Labtec Inc.**, Vancouver, WA; 360-896-2000; www.labtec.com (ORS 577).

► **Play Snappy Video Snapshot 3.0** Play Inc.'s new Snappy Video Snapshot (\$100 street) takes image capture to the next level: video. Hook the small box to your PC's parallel port and plug in your video source (camcorder, VCR, or TV), and the Snappy's chip set digitizes the video stream into an AVI file for use in multimedia presentations or on the Web. The easy-to-use software lets you add effects and titles for a polished look. **Play Inc.**, Rancho Cordova, CA; 800-306-7529; www.play.com (ORS 601).



◀ **NuReality Vivid 3D Proex** Spill up your PC speakers with NuReality's Vivid 3D Proex controller (\$79.95 list). The sleek Proex sits between your sound card and speakers and adds SRS "3-D". The intuitive controls let you adjust the level of enhancement and include a handy volume knob. **NuReality**, Santa Ana, CA; 800-501-8086; www.nureality.com (ORS 592).

■ **WinRadio WR-1000i** If TV isn't your game, the WinRadio WR-1000i (\$499 list) turns your PC into a scanning radio for receiving shortwave broadcasts, police and emergency frequencies, and more. The tuner's range of 500 KHz to 1.3 GHz works in AM, FM, SSB/CW and Narrow FM modes. Windows software lets you store frequencies and set scan ranges. Visitone, a neat graphical spectrum display, shows you all the radio activity in a given range. **WinRadio Communications**, Melbourne, Victoria, Australia; 800-438-8155; www.winradio.com (ORS 620).

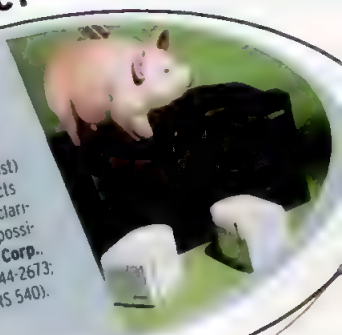


► **AVerMedia TV Genie** Turn your PC into a TV and keep track of news, sporting events, or daytime TV while you work or surf the Net. The AVerMedia TV Genie (\$130 street) is an external tuner box that accepts a regular antenna, cable feed, or input from a VCR. The tuner controls let you quickly scan and set available channels, set its automatic timer, or listen to just the audio portion of broadcasts. **AVerMedia Technologies Inc.**, Fremont, CA; 800-863-2332; www.avermedia.com (ORS 536).



WHEN MONEY'S NO OBJECT

Bose Acoustimass If music and gaming are your PC life, treat yourself to a set of Bose Acoustimass speakers. At \$699 (list) they aren't cheap, but sound effects and musical passages achieve a clarity and realism we didn't think possible from PC speakers. **Bose Corp.**, Framingham, MA; 800-444-2673; www.bose.com (ORS 540).



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OVER THE EDGE?

TRAVEL ARSENAL

Life on the road is tough enough. Let these products make it easier.

1 Sony Voice File ICD-70 Note to Self: Sony's palm-size ICD-70 (\$200 street) lets you record up to 24 minutes of distortion-free personal voice messages when you're out and about. You can then download the messages to your PC (with Sony's \$50 WAV-link software bundle and cable connector) for inclusion in e-mail and the like. **Sony Electronics Inc.**, Park Ridge, NJ; 800-272-7669; www.sony.com (ORS 612).

2 Kensington MicroSaver Security System The Kensington MicroSaver Security System (or Kensington Lock, for short) is an \$80 (street) cable lock that is lightweight yet strong. Simply loop it around a table leg or another immovable object in your hotel room or office and click the lock into place. Most laptops now have a square hole to accept the lock molded into their cases. **Kensington Technology Group**, San Mateo, CA; 800-535-4242; www.kensington.com (ORS 574).

3 PORT AcoustiCoupler 100 If you travel frequently, especially abroad, you can't always be sure to find a standard phone jack to plug your modem line into. The AcoustiCoupler (\$135 direct) from PORT will let you connect the old-fashioned way: It straps onto a standard telephone handset to make the connection. **PORT Inc.**, Norwalk, CT; 800-242-3133; www.port.com (ORS 602).

4 Panasonic KXL Portable CD-ROM Drives Not every laptop has a CD-ROM drive, especially with the trend toward ultrathin ultraportables. Panasonic's KXL family of portable drives (around \$400 street)—which now spin at rates of up to 20K—easily link to your notebook's PC Card slot. You can take a drive along only when you need to, without lugging the extra weight around the clock. **Panasonic Computer Peripheral Co.**, Secaucus, NJ; 800-742-8086; www.panasonic.com (ORS 596).

5 Canon BJC-80 This battery-powered four-color ink jet printer is compact (2.2 by 11.8 by 6.2 inches) and weighs just 3 pounds, yet it delivers the output quality of a standard desktop printer, so you can generate contracts or make that last-minute fix to presentation overheads. The BJC-80's (\$300 street) rechargeable battery pack can print up to 200 sheets between charges. **Canon Computer Systems Inc.**, Costa Mesa, CA; 800-848-4123; www.ccsi.canon.com (ORS 545).

■ **Travel Toolkit** PORT, Konexx, Road Warrior International, and 1-800-Batteries each offer a mix of power and communications accessories for the mobile professional. From the ordinary to things you've wished for but didn't know anybody made. We've picked just a few of our favorites.

True road warriors who spend time in their cars will appreciate PORT's In-Car/In-Flight Charger (\$79.95

direct), which lets you use a car cigarette lighter to recharge your laptop's battery. This 3-ounce device has a special locking mechanism to ensure that it won't fall out of the cigarette lighter; the built-in LED will tell you when it's done. When the juice is running low on your laptop's battery and you need that extra hour or two to finish writing a report, you're ready for the **PORT Charger/Condition-**

er (\$149.95 direct). This handy gadget can rapid-charge two batteries at the same time, and it can condition your batteries for optimal memory usage to preserve battery life. It comes with a universal AC adapter for worldwide use, and it includes an LED light like its sibling, the In-Car Charger.

In the same vein is the **Portable Power Pack** (\$179 direct) from 1-800-Batteries, an external power

brick that doubles your laptop's battery. The pack itself weighs less than 3 pounds, and you can recharge it by plugging it into either a wall outlet or a car's cigarette lighter.

For neater communications on the road, pack the **PORT Retractable Telephone Cord** (\$14.95). The credit card-size container holds 8 feet of spring-loaded telephone cord and reels up in a matter of seconds. The **Modem Doubler** (\$149.95 direct)

from Road Warrior International will let you safely connect your data/fax modem to any modular phone jack—even digital lines that could fry your analog modem.

When there's no telling what exotic locations you'll wind up in, there's also no telling what type of telephone equipment you'll find there. PORT's **Travel Connection Packs** (\$99 to \$199 direct), organized according to regions of the world,

6 New Media LapTalk New Media's LapTalk (\$60 street) are compact, 1-pound speakers (with built-in microphones) that clip to your PC to provide good sound. Powered via your machine's mouse port, the speakers are ideal for one-on-one presentations or videoconferencing. **New Media Corp.**, Irvine, CA; 800-227-3748; www.newmediacorp.com (ORS 587).

7 Targus Shuttle So now you've got a laptop, a portable printer, a CD-ROM drive, speakers, and every adapter known to man. How to transport it all? Try the Shuttle (\$200 street), by Targus. The size and shape of a traditional wheeled carry-on case, the Shuttle offers padded compartments for your computer equipment and accessories. **Targus**, Buena Park, CA; 714-523-5429; www.targus.com (ORS 614).



DeLorme Tripmate DeLorme's Tripmate GPS Receiver (\$160 street) can pinpoint your location using signals from the Global Positioning Satellite system and feed the signals to the company's Street Atlas USA software on your notebook. You'll know where you are and how to get to where you're going. **DeLorme**, Yarmouth, ME; 800-511-2459; www.delorme.com (ORS 554).

AirMedia NewsCatcher Internet Antenna Thanks to AirMedia's NewsCatcher Internet Antenna (\$79 direct), you're never cut off from the Internet when traveling. Just plug the 4.5-ounce unit into your laptop's serial port, and you'll receive push content from AirMedia's Live Internet Broadcast Network (\$5.95 a month). **AirMedia Inc.**, Newport Beach, CA; 800-247-6334; www.airmedia.com (ORS 526).



Coach Organizer Brief To really make a fashion statement, consider the Coach Organizer Brief (\$498 list). It cradles your laptop in a protective lining and has plenty of room for accessories and papers. **Coach**, New York; 800-223-8647; www.coach.com (ORS 549).

Kensington Associate If your needs (or budget) don't warrant such a costly laptop bag, consider one of our favorite, more affordable models: the \$70 (street) Associate. It offers two roomy compartments plus a large outer pocket with a handy pouch for a cell phone. **Kensington Technology Group**, San Mateo, CA; 800-535-4242; www.kensington.com (ORS 574).



Kensington Wetsuit Made of stretchy, stylish neoprene, Kensington's Wetsuit laptop cases (\$49.95 list) come in sizes for regular and subnotebooks. The CD Wetsuits (\$9.95 to 19.95) can hold 12 to 36 CDs in their protective sleeves. **Kensington Sports**, San Mateo, CA; 800-535-4242; www.kensington.com (ORS 573).

can help. Each comes with a complete set of jacks and clips for the region covered, along with a booklet that shows you which equipment to use for the country you're in and how to set it up. Business travelers in foreign cities often have a hard time connecting their PCs to phones because of complex variations in session settings and parameters. Thanks to the **Konexx AutoSet** (\$199 list), you can now just plug in and go; the

device autodetects a wide range of settings, securing a solid connection no matter where you are. **1-800-Batteries**, Reno, NV; 800-228-8374; www.800batteries.com (ORS 520). **PORT Inc.**, Norwalk, CT; 800-242-3133; www.port.com (ORS 602). **Road Warrior International Inc.**, Santa Ana, CA; 800-274-4277; <http://warrior.com> (ORS 605). **Konexx**, San Diego, CA; 800-275-6354; www.konexx.com (ORS 576).

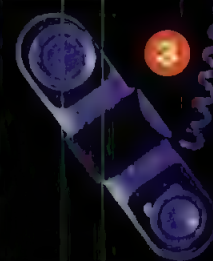
ZERO Halliburton ZC3-SI Prefer an indestructible neoindustrial look? ZERO Halliburton has a full line of laptop cases molded of aerospace-quality aluminum. The 5.5-pound ZC3-SI (\$259 direct) is the size of a standard briefcase and can fit your laptop and accessories in its roomy cushioned interior. **ZERO Halliburton**, North Salt Lake, UT; 800-547-8192; www.zerohalliburton.com (ORS 625).

PORT, Tenda, and Tumi Laptop bags in the world of laptop carrying cases, three names stand above the rest for durability and innovative design: PORT, Tumi, and Tenda. Each company makes a range of bags to fit any business traveler's needs and style, from shoulder bags to backpacks to convertibles that can serve as either, available in ballistic nylon (prices quoted below) or leather.

PORT pioneered the U-shaped sling that suspends your laptop away from the floor and out of harm's way and now licenses it to others. Many PORT bags use the company's new air-cushion system, including the ultralight (less than 3 pounds) **Mobile Lite Carrying Case** (\$79 list), a minimalist bag that still has convenient extras such as a repositionable divider in the main compartment, an expandable compartment for files and accessories, and dividers to keep travel documents and pens within reach.

The **C12 CBP-P Computer Back Pak PRO** (\$200 list) from TENDA is a roomy bag (14 by 18 by 6 inches), big enough for whatever portable PC equipment you need to tote. It features two large main compartments, three additional zippered compartments, and five outside pockets.

Two models from Tumi we like are the mid-sized **Tumi Safecase Deluxe Organizer Computer Brief** (\$335 list) and the **Safecase Deluxe Computer Briefpack** (\$325 list). The Deluxe features the suspension sling in its three-compartment main body, plus two large outer compartments for travel documents, a paperback, a personal stereo, or whatever. The Briefpack sports even more useful compartments: the chief one a separate top section to keep smaller items from getting lost in the main body of the case. **PORT Inc.**, Norwalk, CT; 800-242-3133; www.port.com (ORS 602). **TENDA**, New York; 800-328-3622; www.tenda.com (ORS 615). **Tumi Inc.**, Middlesex, NJ; 800-322-8864; www.tumi.com (ORS 617).



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- 32X Max⁴ Variable CD-ROM Drive
- NEW Turtle Beach Montego A3D 64 Voice Sound Card
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- Iomega Zip 100MB Internal Drive
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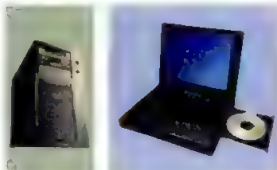
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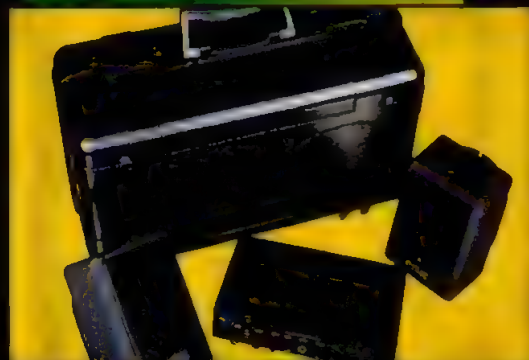
PRESENTATION HARDWARE

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1 Interlink RemotePoint For any presenter, a remote mouse pointer is a must: It allows you to stand and face your audience while controlling your PC-based presentation, instead of hunching over your laptop. Interlink Technologies makes a full line of remotes, and one of our favorites is the RemotePoint Cordless Mouse (\$100 street). It combines an infrared mouse and cursor controller with a standard red laser pointer so you can make your point known. The RemotePoint's red laser light can cast a dot on a screen up to 50 feet away, and its programmable buttons can operate the controls in all major presentation software packages. **Interlink Electronics Inc.**, Camarillo, CA; 800-340-1331; www.interlinkelec.com (ORS 572)

2 Focus Enhancements TView Silver Most conference rooms won't have a large data monitor to connect your PC to, but usually a television will be available. To use it to display your Microsoft PowerPoint presentation, you'll need to carry a good scan converter such as the TView Silver (\$249 list). This unit can convert a laptop's 800-by-600 SVGA signal to standard video for viewing on any TV. It can maintain a 72-Hz refresh rate for a flicker-free image, and it includes pan and zoom features via the included infrared remote. **Focus Enhancements Inc.**, Sudbury, MA; 800-538-8865; www.locusinfo.com (ORS 558)

3 Mediaphile Presentation Audio System The loud quality and volume from your laptop's speakers are too anemic for a typical conference room. The Presentation Audio System (\$249.95 list) from Mediaphile Technologies should help. Available through Fujitsu PC Corp., TransMonde, and others, the unique dome-shaped satellites weigh only 2 pounds total and use the tabletop as a sounding board to deliver room-filling omnidirectional sound with or without the matching 5-pound subwoofer. **Mediaphile Technologies Inc.**, Minneapolis; 612-559-1019; www.mediaphile.com (ORS 581)



Cambridge SoundWorks Model 12 For auditorium-filling sound, consider the Cambridge SoundWorks Model 12 portable amplifier and speaker system (\$649 direct). It comes in a sturdy hard-sided case small enough to fit under an airline seat and contains a pair of two-way satellite speakers, a three-channel amplifier, and a powerful built-in subwoofer. **Cambridge SoundWorks**, Newton, MA; 800-367-4434; www.hifi.com (ORS 544).

Mind Path PocketPoint One of the most diminutive remote controls/pointers we've found is the new PocketPoint (\$100 street) from MindPath. It features four easy-to-navigate programmable buttons to run your PC presentation, and the laser pointer can put a dot on the screen from 50 paces. It comes with Mind Path's excellent Presentation FX software for adding special effects. **Mind Path Technologies Inc.**, Dallas; 800-736-6830; www.mind-path.com (ORS 584).



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▲ **ThrustMaster NASCAR Pro Racing Wheel** The ultimate toy for any driving-game enthusiast, ThrustMaster's NASCAR Pro Racing Wheel (\$139.95 direct) is an outstanding controller. The device comes in two parts: a large steering wheel console that sits on your desk and a gas/brake pedal control that rests on the floor. The console has two buttons, a gear shifter, and a well-crafted, realistic-feeling steering wheel. The pedals also feel realistic, with a loose gas pedal and a tighter brake. If you're into such games as CART Precision Racing or The Need for Speed II SE, the NASCAR Pro Racing Wheel is the perfect accessory. **ThrustMaster Inc.**, Hillsboro, OR; 503-615-3200; www.thrustmaster.com (ORS 616).

▼ **Microsoft SideWinder Force Feedback Pro** Although CH Products' Force FX was the first joystick to support force feedback—a technology that allows players to feel tactile responses from their actions in a game—Microsoft's SideWinder Force Feedback Pro (\$160 street) is the best. Essentially, this is the same controller as the SideWinder Precision Pro, with all the same buttons and features, plus a little motor inside that allows it to shake, rattle, and roll in your hand. For example, the stick can simulate the effects of a car engine idling, a machine gun firing, and even a person jumping up and down. The bundle also includes three force feedback-enabled games: Shadows of the Empire, Interstate 76, and MDK: Mission Laguna Beach. **Microsoft Corp.**, Redmond, WA; 800-426-9400; www.microsoft.com (ORS 583).

■ **Rock N Ride** The Rock N Ride (\$799 direct) is a motion seat that physically responds to joystick inputs. It runs on a compressed-air engine that allows you to tilt up to 60 degrees in any direction. You can take your monitor along for the ride by strapping it into the integrated monitor rack, and there's also a joystick tray and footrest. **Rock N Ride**, Hesperio, CA; 888-431-9893; www.rocknride.com (ORS 606).

▼ **Altec Lansing ACS48 Power Cube** The gaming experience isn't complete without wall-shaking sound, and the best PC gaming system we've found is the Altec-Lansing ACS48 PowerCube Plus (\$150 street). The satellites feature a 20-watt amplifier, and the oversize subwoofer pumps out 40 watts of power. The sound is loud, spacious, and dominated by a powerful low end. In a word, perfect. **Altec Lansing Technologies Inc.**, Milford, PA; 800-258-3288; www.altecmm.com (ORS 530).



► **Saitek X36 Ultimate Flight Controller** For the action and flight simulation fan who craves power and precision, Saitek's X36 (\$150 street) is indeed the Ultimate Flight Controller. This two-component combination includes a joystick and throttle control. The joystick has a primary fire button, three additional buttons, two hat switches, and dials that allow you to adjust the tension on the handle's x and y axes. The throttle, which plugs into the joystick, is an aircraft-style speed control that includes a rudder control, another hat switch, a laptop-style mouse control, a secondary fire button, and two rotary controls. **Saitek Industries Ltd.**, Torrance, CA; 800-452-4377; www.saitek.com (ORS 607).

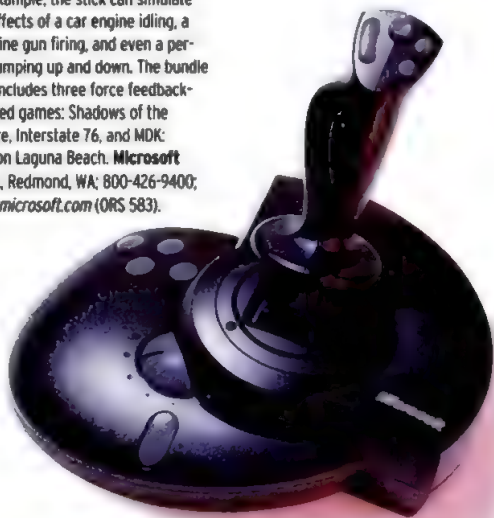


■ **Microsoft SideWinder Precision Pro** A sleeker, updated incarnation of the original SideWinder 3D Pro, Microsoft's latest joystick is a good bet for anyone who needs a reliable, responsive, and affordable game controller. Like its predecessor, the Precision Pro (\$75 street) has eight programmable buttons, a throttle control, and a swiveling handle that acts as a rudder. An eight-position hat switch rounds out the array of buttons. **Microsoft Corp.**, Redmond, WA; 800-426-9400; www.microsoft.com (ORS 583).



▲ **CH Products Joystick Switchbox** Switching among a joystick, a steering wheel, and other assorted gadgetry can be a major hassle for PC gamers. Enter the Joystick Switchbox (\$25 street) from CH Products. You can use it to connect up to four game controllers simultaneously, allowing one-button switching between components—even in the middle of a game. **CH Products**, Vista, CA; 800-624-5804; www.chproducts.com (ORS 547).

■ **ThrustMaster Rage 3D A** Superbly designed controller, the Rage 3D (\$39.95 direct) is the best game pad we've seen in terms of comfort and responsiveness. The large semicircular device is easy to hold, and the unique trackball-style directional control is easy to handle with the left thumb. The Rage 3D has a total of 10 buttons, including two triggers on the bottom of the unit. The pad's premier feature, however, is its amazing responsiveness. The smoothly rolling directional control allows fast and precise maneuvering. **ThrustMaster Inc.**, Hillsboro, OR; 503-615-3200; www.thrustmaster.com (ORS 616).



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There's no substitute for arcade-style 360-degree immersion. The Philips Scuba Visor (\$299 direct) is compatible with gaming consoles as well as with NTSC-compatible PCs. The Scuba provides dynamic stereo sound, a wide field of view, and an adjustable ergonomic design. **Philips Immersive Products**, Palo Alto, CA; 888-728-2232; www.scubafx.com (ORS 598).





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▼ **Bausch & Lomb PC Magni-Viewer** Those who work with text and spreadsheet documents all day should consider the PC Magni-Viewer (\$250 direct) from Bausch & Lomb. The high-quality optical lens magnifies the screen image by 175 percent, so you can see data without constantly zooming in or changing screen resolution. It's fully adjustable and swings aside for normal viewing. **Bausch & Lomb Inc.**, Rochester, NY; 800-452-6789; www.bauschvision.com (ORS 538).

▲ **Workplace Designs Floating Arms Keyboard** There's no need to strain yourself when typing at your PC, thanks to the Floating Arms Keyboard (\$499 direct) from Workplace Designs. Designed by an orthopedic surgeon and an occupational therapist, the keyboard allows you to keep your hands and wrists in a neutral position as you type. Essentially an ergonomic keyboard that's been split in half, it attaches to the armrests of many office chair models. The right half includes a touchpad and numeric keypad, and both sides can tilt in three different directions for maximum comfort. **Workplace Designs**, a division of Cramer Inc., Stillwater, MN; 888-881-7592; www.wpdesigns.com (ORS 622).



▲ **Newell CRT Valet** A computer-monitor arm will let you place your monitor in just the right position (slightly below the direct line of sight) and can be easily adjusted for different users of the same workstation. There are many fine models available, including the CRT Valet (\$115 street) from Newell, which clamps to your desk and can support a 15-inch monitor. **Newell Office Products Co.**, Madison, WI; 800-356-8368; www.officeproducts.com (ORS 588).

► **Neutral-Position Mice** Several vendors have hit on the idea of keeping the hand and wrist in a natural-repose position, to keep pressure off the soft underside of the arm and put less stress on the forearm and wrist ligaments. The **Goldtouch Mouse** (\$69.99 direct) features programmable buttons and scrolling, and angles your hand gently outward. The **Anir Ergonomic Mouse Pro** (\$69.99 direct) from AnimaX is even more extreme. This full-function mouse is shaped like a joystick, letting your hand and forearm fall into the relaxed handshake position. **Goldtouch Technologies Inc.**, Irvine, CA; 714-798-0300; www.goldtouch.com (ORS 562). **AnimaX International Inc.**, Woodland Hills, CA; 818-713-9933; www.animax.no (ORS 532).

▼ **Plantronics CAT132 Headset** If you often need to talk on the phone while typing, cradling the phone between your ear and shoulder is sure to cause neck pain eventually. Switch to a telephone headset, such as the ultracomfortable CAT132 Headset (\$69.95 list) from Plantronics. It's lightweight, and the adjustable boom assures a perfect fit. **Plantronics Inc.**, Santa Cruz, CA; 800-544-4660; www.plantronics.com (ORS 600).



■ **Constant Key Motion Rist Rocker** One of the more clever approaches to alleviating keyboard-related wrist stress is the Rist Rocker (\$350 direct), from Constant Key Motion. This motorized platform fits securely under your keyboard and, in slow intervals, moves your keyboard up and down at an angle—thus preventing your wrist from making repetitive motions that can cause fatigue, pain, and injury. **Constant Key Motion Inc.**, Woodway, TX; 254-776-6426 (ORS 550).

■ **Newell ComfortTread Plus Footrest** Keeping your feet properly elevated can help keep pressure off your lower back as you work. The ComfortTread Plus Footrest (\$34.99 list) from Newell Office Products Co. tilts forward and backward to increase circulation to the feet and ankles, and its height-adjustment option allows you to raise or lower it to your preference. For even more podiatric pleasure, rub your soles on the bumpy surface massagers. **Newell Office Products Co.**, Madison, WI; 800-356-8368; www.officeproducts.com (ORS 588).

■ **3M Adjustable Keyboard Tray** The height of the typical office desk was designed for writing, not typing. Having the keyboard at desktop level forces your elbows and wrists into unnatural (and uncomfortable) positions. Invest in an under-desk keyboard tray, such as the Adjustable Keyboard Tray (\$444 list) from 3M Office Ergonomics. The handy tray has adjustable tilt and height controls as well as built-in gel wrist rests for your comfort and support. And its unique sliding mouse platform allows you to pick your preferred location for mouse usage. **3M Office Ergonomics**, St. Paul, MN; 800-332-7483; www.mmm.com (ORS 522).

▼ **Gel to the rescue** Many users find that a hard wrist rest can be uncomfortable for long periods and can also be potentially damaging to the delicate nerves running through the wrist. A number of pliant gel-filled rests have come to market, including the **Gel Wrist Rest** (\$19.95 list) from Fellowes. We also like the **CaseLogic Gel-ez Mousepad with Wrist Rest** (\$19.95 list), a sharp-looking pad that features a soft, comfortable support area. **Fellowes Manufacturing Inc.**, Itasca, IL; 800-955-3344; www.fellowes.com (ORS 557) **Case Logic Inc.**, Longmont, CO; 303-530-3800; www.caselogic.com (ORS 546).



► **Bausch & Lomb Computer Eye Drops** Why does working at a computer screen often cause our eyes to burn? Simply, we tend to blink less when we focus close up. Computer Eye Drops (\$6 direct) from Bausch & Lomb are specially formulated to replenish lost moisture, and Bausch & Lomb says they're safe to use as often as needed. **Bausch & Lomb Inc.**, Rochester, NY; 800-452-6789; www.bauschvision.com (ORS 538).



■ **OCLI GlareGuard Maximum** Long hours gazing at a CRT with typical office lighting can be tough on your eyes. To minimize reflections and sharpen contrast, the **GlareGuard Maximum** (\$155 list for the 17-inch size) from Optical Coating Laboratory fits over your monitor and reduces 99 percent of glass glare and ELF/VLF E-field radiation. Other models include a 62 percent LiteTint version (for brighter colors), as well as 31 HighContrast models for sharper text. **Optical Coating Laboratory Inc. (OCLI)**, Santa Rosa, CA; 800-545-6254; www.glareguard.com (ORS 594).

■ **DTI Group Internet Surfer Buddy** Long sessions in front of a PC can cause pain in some of your body's more tender regions. To give your lower back a little love and attention, try the Internet Surfer Buddy (\$44 direct) from DTI Group. When placed on your chair, this ergonomic cushion gradually molds to the shape of your body (thanks to its internal gel pack), allowing for more comfortable seating, improved posture, and reduced fatigue and back strain. **DTI Group Inc.**, Garland, TX; 800-283-1947; <http://malls.com/surferbuddy> (ORS 555).

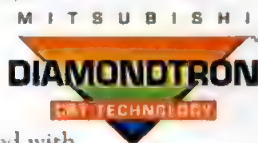


◀ **Grahl Synchronic 2 Hugger DuoBack with keyboard arm rests** One of the most comfortable office chairs we've parked ourselves in is the DuoBack (\$1,330 list) by Grahl. Its unique split-back design cradles each side of your back independently, keeping pressure off your backbone and allowing freer movement. **Grahl Industries Inc.**, Coldwater, MI; 880-289-4724; www.grahl.com (ORS 563).

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These accessories will help the little ones get a head start in computing.



▲ RF-Link My First Keyboard Does your toddler like to sit on your lap when you're working at the computer? Maybe it's time for RF-Link's **My First Keyboard** (\$70 street), specially designed for kids 2 to 5 years old. This colorful, lightweight unit has no sharp or protruding parts, and the A-to-Z arrangement of the letters and included games will help children learn the alphabet. It plugs into a standard keyboard port and is coated with an easy-wipe, peanut butter-proof surface; and it comes with several children's applications. **RF-Link Technology Inc.**, Torrance, CA; 888-275-5465; www.rflinktech.com (ORS 604)

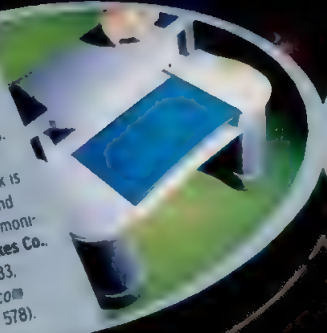
● kidBoard Designed specifically for children, the kidBoard (\$70 street) is a sturdy, color-coded QWERTY keyboard that helps kids learn to touch type while getting comfortable with a computer. Each letter key is accompanied by an icon indicating a familiar word that begins with that letter, and the keys are color-coded for the right and left hands. The kidBoard also comes bundled with three children's games. **kidBoard Inc.**, Eden Prairie, MN; 800-926-3066; www.kidboard.com (ORS 575).

● CalComp Learn 'n Sketch The Learn 'n Sketch (\$70 street) from CalComp is a colorful electronic pen tablet that your kids can use to bring out their creative streak by making their own computer drawings. The bundled software will help them learn reading and writing skills by tracing letters and pictures. **CalComp Inc.**, Scottsdale, AZ; 800-458-5888; www.calcomp.com (ORS 543).

■ SketchBoard The SketchBoard (\$100 street) from kidBoard is an 8-by-6-inch drawing tablet that lets kids make and save their own computer art. Using the special tracing insert, they can copy their favorite Sunday comics or make portraits of family members and see it all on screen. The bundle includes Disney's Magic Artist software. **kidBoard Inc.**, Eden Prairie, MN; 800-926-3066; www.kidboard.com (ORS 575).

WHEN MONEY'S NO OBJECT

Little Tikes Computer Center This Adjustable Computer Center (\$149.99 list) is just the right size for grade schoolers. Equipped with adjustable shelves that can grow as your children do, the desk is made to withstand years of abuse and provides room for the computer, monitor, and accessories. **Little Tikes Co.**, Hudson, OH; 800-321-0183; www.littletikes.com (ORS 578).



● Microsoft EasyBall A regular mouse or trackball just isn't the right size or shape to let a child navigate the computer screen successfully. The Microsoft EasyBall (\$55 street) is an oversize (and over-yellow) trackball that's easy to use and easy to clean. It includes activity software to help kids learn to move the cursor with precision. **Microsoft Corp.**, Redmond, WA; 800-426-9400; www.microsoft.com (ORS 583).

● Microsoft Actimates Interactive Barney Your child will love this talking replica of PBS's popular Barney character. Interactive Barney (\$110 street) responds to radio signals transmitted by a device that plugs into your PC. Together, Barney and your child can watch fun, educational videos (included) as Barney makes comments reinforcing positive themes. Barney is also programmed to play peek-a-boo and 12 games and to sing 17 songs. **Microsoft Corp.**, Redmond, WA; 800-426-9400; www.microsoft.com (ORS 583).

ESSENTIAL ORGANIZERS

Keep your desk neat and media within reach with these clever accessories.

► **Allsop 4Media Organizer, Kensington QuickTrieve** To keep your CD-ROMs, floppy disks, Zip disks, and other media from morphing into an unstable and unusable pile on the corner of your desk, spend a few dollars on a handy caddy. We like the Allsop 4Media Organizer (\$9.99 list), which can hold floppy disks, Zip disks, PC cards, and CDs in various combinations. Kensington's QuickTrieve (\$10 street) can hold 16 CDs, 18 Zip disks, 64 floppy disks, or a combination, and its padded top lets you place it under your PC speaker for even more efficient use of space. **Allsop Inc.**, Bellingham, WA; 800-426-4303; www.allsop.com. **Kensington Technology Group**, San Mateo, CA; 800-535-4242; www.kensington.com (ORS 574).



■ **ComputADrawer** Do you have an empty 5.25-inch drive bay in your PC and no plans to use it? Then the ComputADrawer (\$10.95 direct) is right for you. Simply pop off the faceplate of the unused bay, attach the guide rails, and slide in the drawer. It gives you convenient, hidden storage for floppy disks, pens, or other items. **MJR Marketing**, Los Angeles; 213-624-5510; <http://home.pacbell.net/coastale/computadrawer.html> (ORS 626).

▲ **C Skate** If you need to get to the back of your PC to connect or disconnect peripherals often (or just occasionally), you know how frustrating it can be. C Skate computer platforms (from \$64.95 direct) can help. These super-strong, low-profile platforms, available for tower PCs, desktops, and monitors, put your machine on wheels to make access a snap. **C Skates**, Seattle; 206-542-5641; www.cskates.com (ORS 542).

◀ **Zelco Mouse Trap** Have you hugged your mouse today? Probably not, but on that crowded desk, under that report you forgot to hand in, your mouse just waits, taking up space. Zelco has come up with a way to solve at least some of your desk clutter problem with the Mouse Trap mouse holder (\$13 direct). The Mouse Trap mounts to your monitor and holds your mouse with articulated arms for safekeeping, freeing that prized cubicle space for more important things, like lunch. To complete the look, Zelco sells a matching document clip (\$13 direct) and bud vase (\$13). **Zelco Industries Inc.**, Mount Vernon, NY; 800-431-2486; www.zelco.com (ORS 624).

▼ **Case Logic CT-6 Cable Ties** The perfect complements to the Guidewires are Case Logic's CT-6 cable ties (\$3.99 list). These velcro bands wrap securely around large cables to help keep them neat, and they are color-coded so you know which wire connects to what. **Case Logic Inc.**, Longmont, CO; 303-530-3800; www.casellogic.com (ORS 546).

► **Allsop Guidewires** Say goodbye to maddening, tangled computer cables jumbled behind your desk. The Allsop Guidewire (in the Cable Control Kit, \$7.95 list) keeps your cables straight and clearly separated by aligning them in a plastic holder that sticks to the back of your desk. The Guidewire opens easily to allow insertion and removal, and it works equally well with any kind of wire—power cables, component wires, even stereo equipment connectors. **Allsop Inc.**, Bellingham, WA; 800-426-4303; www.allsop.com (ORS 529).



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Photoshop Productivity

Time in seconds (shorter is better)



Both computers were loaded with their maximum RAM. Score is time in seconds to complete three Photoshop 4.0 tasks with a 188MB RGB image. Measured tasks were 0.5 gaussian blur, mode change to CMYK, and resize image to 50%. See web for details.

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S900BASE w/G3 has 64MB RAM, AGP 7200rpm SCSI HD, 24x CD-ROM and ships with our unique G3 card. This G3 card is a UMAX edition MAXpower Pro-250MHz PowerPC 750 processor card with a full 1MB backside cache running at 166MHz. (Estimated street price: \$2995. Monitor not included. Price and features subject to change without notice. See web for details. © 1998 All rights reserved. SuperMac is a registered trademark licensed to UMAX Computer Corporation. Mac and the Mac OS logo are trademarks of Apple Computer, Inc. used under license. PowerPC and the PowerPC logo are registered trademarks of International Business Machines Corporation.

PC CARDS

That slot in your laptop can open a world of new functionality.



▲ **Integral Peripherals Viper Series** Thanks to the Integral Viper Series, you can store all the data you need and bring it with you as you travel. These PC Card hard disks—ranging in size from 85MB to 340MB (\$220 to \$275 street)—feature hard-disk performance and low power consumption, combined with removability. They're ideal for storing sensitive or important data you want to keep separate from your laptop, and the high capacity means you can store an application and associated files and shuttle them to any laptop with a Type II slot. **Integral Peripherals Inc.**, Boulder, CO; 800-333-8009; www.integralnet.com (ORS 569).

▲ Adaptec SlimSCSI 1460

Another essential PC Card companion is the adaptec SlimSCSI 1460 adapter (\$160 street). This plug-and-play Type II adapter lets you connect any SCSI device—removable drives such as Zip, Jaz, SyJet or CD-R; color scanners; and CD-ROM drives—to your portable PC and gain the speed of SCSI (up to six times as fast as a parallel-port connection). **Adaptec Inc.**, Milpitas, CA; 800-442-7274; www.adaptec.com (ORS 524).

▶ New Media Basics Gameport

When work is done and the hotel bar closes, retire to your room and kill, kill, kill. Featuring a DB-15 joystick connector, the Basics Gameport (\$64 street) from New Media Corp. provides a standard connector so you can use a joystick or game pad to play Doom, rather than a cramped laptop keyboard. **New Media Corp.**, Irvine, CA; 800-227-3748; www.newmediacorp.com (ORS 587).

■ **Greystone Type Adapters** Like an instant notebook upgrade, the Type Adapter (\$50 street) from Greystone Peripherals is a handy adapter that lets you use a Type III PC Card with a system that has only Type I or Type II slots. **Greystone Peripherals Inc.**, Los Gatos, CA; 800-600-5710; www.grystone.com (ORS 564).

■ **Eicon DIVA Pro** ISDN service is becoming much more prevalent, and portable PC users with access at the home or office should invest in an ISDN PC Card modem. The Eicon DIVA Pro PC Card (\$399 list) is one we like. It's compact and can double as a standard analog modem when you're on the road. **Eicon Technology Corp.**, Carrollton, TX; 800-803-4266; www.eicon.com (ORS 556).

▶ **Nogatech Notebook TV** The Nogatech Notebook TV (\$399 list) connects to your PC Card slot, providing a TV tuner to display broadcast TV channels on your laptop (it also accepts a cable feed), plus video- and still-image capture from any video source. Use it to videoconference, to capture images for a presentation, or to keep up with Jerry Springer's antics during those long airport layovers. **Nogatech Inc.**, Cupertino, CA; 408-342-1400; www.nogatech.com (ORS 589).

POWER PROTECTION

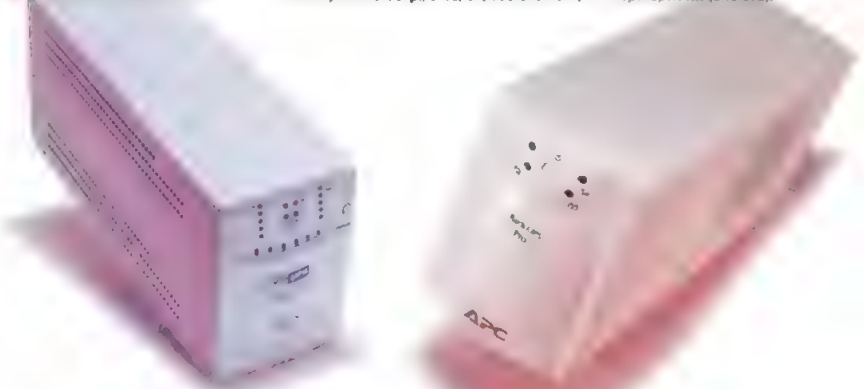
Protect your equipment from spikes and blackouts.



▲ ▲ **Personal Protection** Even if you don't need the safety net a UPS provides, you should at least protect your PC equipment from power spikes and surges. Two of the most clever designs are the **APC SurgeArrest SurgeStation** (\$50 street) and **Kensington SmartSockets** (\$20 to \$50 street). The SurgeStation provides 8 protected outlets and 2 protected modem/network connections. The SmartSockets feature color-coded outlets with matching stickers to tell you which plug belongs to which device. **APC**, West Kingston, RI; 800-877-4080; www.apcc.com (ORS 533). **Kensington Technology Group**, San Mateo, CA; 800-535-4242; www.kensington.com (ORS 574).

■ **Server Technology Remote Power On/Off for Windows 95** For business travelers who need access to their office computers even when they're on the road, the Remote Power On/Off (\$120 street) from Server Technology provides a unique solution. A telephone-activated device that plugs into your serial port, phone line, and electrical outlet simultaneously, it powers up your PC when it detects your remote incoming call. **Server Technology Inc.**, Sunnyvale, CA; 800-835-1515; www.servertech.com (ORS 610).

▼ **Personal Powerhouses** Power outages and rolling brownouts are the most common causes of data loss in the workplace. You can protect yourself with an affordable, simple-to-use UPS (uninterruptible power supply). Two of the best on our tests were the **BackUPS Pro 420** (\$270 street) from APC and the **PowerPS 500** (\$349 list) from Opti-UPS Corp. (a division of Viewsonic). Aimed at SOHO users, these 420-VA units can keep typical PCs and 17-inch monitors running for 6 minutes or more in a blackout. In case you aren't at your PC to shut down safely within that time, the units' software can be set to save open files and shut down automatically. **APC**, West Kingston, RI; 800-877-4080; www.apcc.com (ORS 533). **Opti-UPS Corp.**, Brea, CA; 888-678-4877; www.opti-ups.com (ORS 593).



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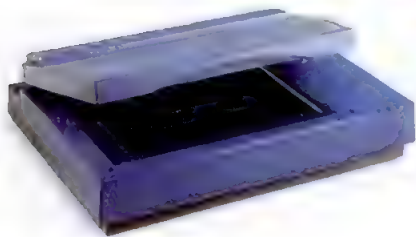
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WHEN DO UPGRADES MAKE SENSE?

**WE UPGRADE TWO PCs
AND COMPARE THEM
WITH NEW SYSTEMS.**

With the rise of MMX technology, mainstream 3-D, SDRAM, Ultra ATA disks, and DVD, much of today's software falls well short of its potential when run on a Pentium/133 PC, circa 1995. In case you want to take advantage of the new software, the question is not whether you should continue with inadequate hardware but whether you should upgrade your current system or buy a new one. *PC Magazine* examines that question by comparing two new desktops with a pair of older PCs—one a 486DX2/66 model

ILLUSTRATIONS BY DAVE ALBERS

BY CADE METZ

Motherboard Upgrades vs. New PCs

Here are the basic features and benchmark test results for our base 486 and Pentium/100 units—along with comparison data for the same systems with motherboard upgrades and finally for two new PCs. Remember that software packages often will be bundled with new systems.



	BASE 486	486 WITH MOTHERBOARD UPGRADE	BASE PENTIUM/100
Total cost	Already owned	\$650 street	Already owned
CPU	486 DX2/66	Pentium MMX/233	Pentium/100
RAM	16MB DRAM	32MB EDO SIMMs (\$180)	16MB EDO DRAM
L2 cache	256K asynchronous	512K pipelined-burst	512K pipelined-burst
Hard disk	425MB Western Digital	425MB Western Digital	2.1GB Western Digital
Graphics card	Diamond Viper VLB	Diamond Multimedia Stealth II 220, 4MB SGRAM (\$120)	Diamond Stealth 3D 2000
CD-ROM drive	Sony 2X	Sony 2X	Creative 8X
Sound card	Media Vision	Media Vision	Creative Vibra 16
Modem	None	None	None
Warranty	Expired	2 years (exchange)	Expired
ZD Business Winstone 98	14.9	14.9	14.9
ZD Graphics WinMark 98	1.1	1.1	1.1
ZD Disk WinMark 98¹	1.25	1.25	1.25
ZD 3D WinMark 98	N/A	1.1	1.1

N/A—Not applicable: The product could not complete this test. (1) Thousands of bytes per second. (2) We tested with 32MB of RAM, as required by 3D WinMark 98.

and the other based on a Pentium/100 processor—along with an assortment of hardware peripherals. To show the relative benefit of each new device on a system's performance, we tested 10 different upgrade scenarios with the 486 and 29 different scenarios with the Pentium/100. Our comparison considers performance and price as well as the time and labor involved in the upgrades. We focus on hardware upgrades in this story; software migration issues are complex, and we do not deal with them in detail here.

We found that any user still computing with a 486 CPU should simply purchase a new PC. You can't raise a 486 to the level of today's mainstream desktops without replacing its motherboard—a process that costs almost as much as a factory-built system and may require days of labor.

Conversely, if your current desktop is a Pentium/75 or better, you can improve its performance significantly with

a new CPU and more memory for no more than \$400 and a little effort. (CPU upgrades for 60- and 66-MHz Pentiums are no longer manufactured.) In case you desire 3-D graphics, DVD, or high-end sound, you can add other peripherals, from as little as \$100 to as much as \$400 or more.

THE 486

Our 486DX2/66 PC, a 6-year-old Gateway 4DX2-66V, used a Baby AT motherboard based on the now-obsolete VESA local-bus (VL-Bus) architecture. VL-Bus, a faster alternative to the Industry Standard Architecture (ISA) bus used in the inaugural IBM PC AT, gave way to Peripheral Component Interconnect (PCI) at the dawn of the Pentium era in 1993. The 4DX2-66V held a Viper VL-Bus graphics card from Diamond Multimedia (2MB of VRAM) and an ISA sound card from Media Vision. Other hardware included 16MB of stan-

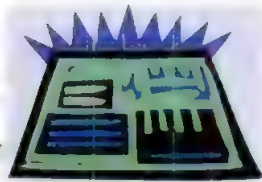
dard DRAM, a 256K L2 cache, a 2X CD-ROM drive, and a 425MB IDE disk.

We tested the 486 under Windows 95 for performance comparison. The unit earned a 3.6 ZD Business Winstone 98 score. The inaugural 333-MHz Pentium II PCs (for details, see "Deschutes Debuts," February 24, 1998)—currently the fastest machines on the mainstream market—are 6 times as fast. Pentium II/333 machines are similarly 9 to 12 times as fast as 486 PCs on our ZD WinBench 98 tests. We also attempted to run our latest ZD 3D WinMark 98 tests, but the 486 PC couldn't complete them within a reasonable time frame (it was barely halfway through after 24 hours).

486: MEMORY UPGRADE

More memory: It's the quickest, easiest, and cheapest upgrade. After adding an additional 16MB (\$80 street) to our original 486 we saw slight improvements—6 to 10 percent—on our Business Winstone 98, ZD Disk WinMark 98, and ZD CPU-mark₃₂ tests. As with most 486 models, the motherboard was outfitted with four stan-

WWW.PCMAG.COM
Join us online for a step-by-step illustrated guide for each upgrade. And check our PC Tech motherboard upgrade feature at www.zdnet.com/pcmag/pcstech/content/16/13/_open.htm.



PENTIUM/100 WITH MOTHERBOARD UPGRADE



HP PAVILION 3260



DELL DIMENSION XPS D233

\$980 street	\$800 street (monitor not included)	\$1,559 direct (monitor not included)
Pentium II/266	Pentium MMX/200	Pentium II/233
32MB EDO SIMMs (\$180)	32MB SDRAM	32MB SDRAM
512K pipelined-burst	None	512K pipelined-burst
2.1GB Western Digital	2.1GB Quantum	4.3GB Quantum
Diamond Stealth 3D 2000	ATI VT2 32-bit (integrated), 1MB DRAM	STB Velocity 3D AGP, 4MB SGRAM
Creative 8X	GoldStar 16X	NEC 32X
Creative Vibra 16	Crystal chip set	Yamaha Wavetable
None	K56flex	x2 (56K)
2 years	1 year; phone support: 24 hours, 7 days	3 years; phone support: 24 hours, 7 days
2.1	1.8	BETTER ►
115	100	BETTER ►
100	100	BETTER ►
100	100	BETTER ►

dard SIMM slots but lacked support for Extended Data Out (EDO) technology, a faster alternative to standard DRAM.

To approach the performance of today's mainstream desktops, the next step with the 486 machine is a motherboard upgrade. Companies such as Evergreen Technologies are still selling upgrade chips for 486 systems (like the AMD 586-133 chip, for \$100 street), but Intel no longer offers OverDrive CPUs, Intel's specially designed upgrade chips, for machines any slower than Pentium/75s.

486: MOTHERBOARD UPGRADE

By replacing our 486's motherboard with a new Socket 7 Pentium-class model from Asus Computer International, we were

able to support some of today's faster components: namely, 16MB of EDO DRAM, a PCI graphics card, and a Pentium MMX/233 CPU. After \$560 and a couple of hours of labor, plus a few more painstakingly resolving IRQ conflicts, we saw Winstone test performance rise from 3.6 to 10.5, and ZD Graphics WinMark 98 performance improved sixfold, to the level of the current home PC low end. Only the CD-ROM score, which is largely independent of the CPU subsystem, failed to increase dramatically.

The Asus Tx97-E, available for roughly \$150 though resellers and retail outlets, adheres to the Baby AT standard we needed. ATX and new NLX designs (the latter with expansion slots on a riser card

for easier motherboard servicing) offer newer chip sets and are similar in size to Baby ATs. CPU and memory placement have shifted to avoid conflict with expansion cards, however, and connectors are in different places. Also, the connector for the power supply is incompatible with earlier power supply cable designs: You'll need a new power supply if you get the wrong motherboard. Before purchasing a new board, verify your motherboard's shape and chassis requirements.

Adding a new motherboard may not be physically difficult, but configuring it to run your OS properly often requires epic patience. Motherboard documentation is typically sparse, so even the most technically adept may need several hours to perform

OUR CONTRIBUTORS Cade Metz and Robert S. Anthony are senior writers for *PC Magazine*. Rich Fisco was the project leader, and Anush Yeghazarian was the associate editor in charge of this story.

EQUIPMENT PROVIDERS PC Labs acquired test-bed hardware from the following vendors, which we thank for their assistance: Intel Corp. (800-548-4725, www.intel.com), Evergreen Technologies (541-757-0934, www.everttech.com), and NEC Computer Systems Division (888-863-2669, www.nec-computers.com) for processors; ASUS Computer International Inc. (408-474-0567, www.asus.com.tw) and Tyan Computer Corp. (408-956-8000, www.tyan.com) for

motherboards; Kingston Technology Co. (800-337-8410, www.kingston.com) for memory; Diamond Multimedia Systems (800-468-5846, www.diamondmm.com) for graphics cards; IBM (800-428-3333, www.ibm.com) for hard disks; Toshiba America Information Systems (800-334-3445, www.toshiba.com) for CD-ROM drives; 3Com Corp./U.S. Robotics (800-638-3266, www.3com.com) for a modem; Creative Labs (800-998-1000, www.creativelabs.com) for DVD kits and sound cards; Altec Lansing Technologies (800-648-6663, www.altecmm.com) for speakers; and Dell Computer Corp. (800-388-8542, www.dell.com) and Hewlett-Packard Co. (800-752-0900, www.hp.com) for comparative systems.

Upgrade Guide for 486 or Pentium Owners

486 Base System If you're starting from a 486, you can get a little over 10 percent better performance from a memory upgrade. But if you want to take full advantage of today's software, you'll need to invest more and upgrade your motherboard or purchase a new system.

IF YOU WANT TO SPEND	TO IMPROVE PERFORMANCE	TO ENHANCE MULTIMEDIA	TO IMPROVE 3-D	TO INCREASE STORAGE
\$200 OR LESS	Upgrade memory to 32MB (\$90).	Upgrade memory to 32MB (\$90) and add a new CD-ROM drive (\$100) or add a new graphics card (\$120).	Upgrade system memory to 32MB (\$90) and/or add a new graphics card (\$120).	Add an Iomega Zip Drive (\$140)
\$500 OR LESS	Upgrade to a Pentium MMX motherboard and increase memory to 32MB (\$440).	Upgrade to a Pentium MMX motherboard and add a new CD-ROM drive (\$450).	Upgrade to a Pentium MMX motherboard (\$350) and add a new graphics card (\$120) or increase memory to 32MB (\$90).	Add a 6.4GB Ultra ATA hard disk and an Iomega Zip Drive (\$440) or add a 1GB Iomega Jaz Drive (\$300); for data backup, consider a Travan-based drive (\$530).
\$1,000 OR LESS	Upgrade to a Pentium MMX motherboard; upgrade memory, hard disk, graphics, and CD-ROM drive (\$960); or buy a sub-\$1,000 Pentium MMX system.	Buy a new \$800 Pentium MMX system; consider upgrading to a PCI wavetable sound card (\$200) or upgrade speakers (\$100).	Upgrade to a Pentium MMX motherboard and upgrade memory, hard disk, graphics, and CD-ROM drive (\$960).	Add a 6.4GB Ultra ATA hard disk and an Iomega Zip Drive (\$440) or add a 2GB Iomega Jaz Drive (\$550); for data backup, consider a Travan-based drive (\$530).
\$1,500 OR LESS	Buy a new Pentium II system.	Buy a new Pentium II system.	Buy a new Pentium II system.	Buy a new Pentium II system.

Pentium Base System Consider a CPU upgrade (performance improved nearly 50 percent) or adding memory (performance improved about 15 percent). From a Pentium MMX base system, consider only targeted upgrades: a faster CD-ROM or DVD drive, better sound, or a 3-D graphics card.

IF YOU WANT TO SPEND	TO IMPROVE PERFORMANCE	TO ENHANCE MULTIMEDIA	TO IMPROVE 3-D	TO INCREASE STORAGE
\$200 OR LESS	Upgrade memory to 32MB (\$90).	Upgrade memory to 32MB (\$90).	Upgrade system memory to 32MB (\$90).	Add an Iomega Zip Drive (\$140).
\$500 OR LESS	Buy an Intel MMX OverDrive CPU and upgrade memory to 32MB (\$390).	Buy an Intel OverDrive CPU, upgrade memory to 32MB, and buy a new CD-ROM drive (\$490).	Buy an Intel OverDrive CPU and upgrade memory to 32MB (\$390) and/or buy a new graphics card (\$120).	Add a 6.4GB Ultra ATA hard disk and an Iomega Zip Drive (\$440) or add a 1GB Iomega Jaz Drive (\$300); for data backup, consider a Travan-based drive (\$530).
\$1,000 OR LESS	Buy an Intel MMX OverDrive CPU and upgrade memory, graphics, hard disk, and CD-ROM drive (\$910).	Buy an Intel MMX OverDrive CPU; upgrade memory, graphics, and CD-ROM drive; add a PCI wavetable sound card and upgrade speakers (\$910).	Buy an Intel MMX OverDrive CPU; upgrade memory, graphics, and hard disk (\$810); add a PCI wavetable sound card (\$200) or upgrade speakers (\$100).	Add a 6.4GB Ultra ATA hard disk and an Iomega Zip Drive (\$440) or add a 2GB Iomega Jaz Drive (\$550); for data backup, consider a Travan-based drive (\$530).
\$1,500 OR LESS	Buy a new Pentium II system.	Buy a new Pentium II system.	Buy a new Pentium II system.	Buy a new Pentium II system.

an upgrade. As with ATX designs, Baby AT models run power or data-transfer cables or both to all major peripherals, power switches, reset buttons, indicator lights, and, occasionally, internal speakers. Unlike ATX designs, Baby ATs usually connect to off-board parallel and serial ports. Cables can be disconnected by hand, but you'll need a screwdriver to remove any obstructing drive bays or expansion cards as well as the motherboard itself.

The Asus Pentium MMX-based board includes Intel's 430TX chip set, 512K of L2 cache, three PCI slots, three ISA slots, and a shared slot. (The CPU was not included on our model.) Though they can't be used simultaneously, both DIMM and SIMM sockets are present, and SDRAM and EDO are supported.

Reconnecting power and reset switch-

es, speakers, and front LEDs after installing the board is fairly intuitive; attaching a major peripheral requires care. We attached the 486's disk and CD-ROM drive using new IDE ribbon cables: We plugged one into the motherboard's primary IDE slot and the other into the secondary slot, then connected the existing floppy disk drive to a dedicated slot. Some PCs have both the disk and CD-ROM drive on the same IDE channel, but plugging them into separate channels with separate cables lessens hassles in the long run. You get a second cable with most new motherboards. Power-cable attachment is relatively easy, because both the connector and receptacle are keyed.

Those with little experience in upgrading PCs might inadvertently attach drive cables upside down, incapacitating the

drive. A colored stripe typically runs along one side of each ribbon cable. When you plug the cable into a motherboard, the colored edge should face pin number 1 of the IDE or floppy disk slot being used. The cable should then go to pin number 1 of the drive, usually the pin nearest the power connector.

The 486's original Media Vision audio card sat on an ISA bus and could be reinstalled on our new board. The Diamond Viper VL-Bus card, however, has become art for the living-room mantel. In place of the Viper, we inserted a Diamond Stealth II S220 (\$120 street) with 4MB of SGRAM, which ran our 3D WinMark tests without difficulty. This PCI-based card is capable of 1,024-by-768 resolution with true color. Because we used our old 15-inch monitor, though, we were limited



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Rx for the Perfect Upgrade

A PC hardware upgrade is not the kind of project you can rush into. Variations in motherboard features, software drivers, and individual peripherals make it impossible to predict how successful an upgrade will be. But a little common sense and a little luck can help you avoid major headaches.—By Robert S. Anthony

PLANNING AHEAD

- ☐ **LIST AND OBTAIN** all the parts you'll need.
- ☐ **TAKE NOTE** of the cables or other components that may have to be moved.
- ☐ **LOOK OUT** for small but essential details. For example, if you intend to install a 3.5-inch hard disk in a 5.25-inch drive bay, you'll need a set of brackets.
- ☐ **DETERMINE** whether you have all the cables you need (as in serial, parallel, PS/2 ribbon, power-connection, drive, and so forth).
- ☐ **ASSEMBLE ALL** the tools you need. A screwdriver and a set of needle-nose pliers are a good start, but unique screws or fasteners may require different tools.
- ☐ **GIVE YOURSELF** plenty of working room on a stable surface.
- ☐ **PLACE SMALL ITEMS** such as screws and jumpers in a container.
- ☐ **USE MASKING TAPE** to label all cables and connectors as you separate them, including the wires connecting the front-panel LEDs to the motherboard.
- ☐ **MAP OUT** your new connections. For example, your old IDE hard disk may be connected to an expansion card, but your new motherboard will probably have an integrated IDE connector. Use the connector, and retire the card.
- ☐ **DON'T DISCARD** anything until your new setup is working perfectly. In case your new setup doesn't work, you should at least be able to get back to where you started.

INSTALLING A MOTHERBOARD

- ☐ **BEFORE YOU SELECT** a new motherboard, take a good look at your old one.
- ☐ **MAKE SURE** your new motherboard has enough ISA slots for your old expansion cards.
- ☐ **SHOP FOR** a new AGP or PCI graphics card if your PC has a VL-Bus graphics card in it, because you won't find a VL-Bus slot on today's motherboards.
- ☐ **FIND OUT** if you're buying the right style of motherboard (ATX, Baby AT, NLX, and so on) for your computer case; check your documentation.
- ☐ **NOTE WHETHER** the new motherboard offers the same types of mouse and keyboard ports as your old one. If not, no problem: Buy the appropriate adapters.
- ☐ **HANDLE** the new motherboard carefully: Don't twist or drop it, and don't force cards or cable connectors into it.
- ☐ **KEEP YOUR NEW** motherboard in its antistatic bag until you're ready to install it.
- ☐ **IF YOUR MOTHERBOARD** is mounted on a small plastic standoff, be careful not to lose it. Better yet, keep an extra one on hand.
- ☐ **DON'T WORRY** if all of the holes on the motherboard do not align with the case: Just make sure the board is mounted firmly in the PC case.

PLAYING IT SAFE

- ☐ **GROUND YOURSELF** with a static-control wrist strap (Radio Shack Catalog, No. 276-2397), or touch the metal part of your computer case often to discharge static.
- ☐ **BEFORE YOU DO ANYTHING**, access your PC's BIOS setup screen (keyboard commands vary. Read your manual) and copy or print all of the data.
- ☐ **BACK UP** all hard disk data and make sure you have a bootable floppy disk handy.
- ☐ **KEEP YOUR PC MANUAL** and your PC vendor's technical-support number and Web address handy.
- ☐ **SURF THE WEB:** Download the latest drivers for your graphics card, hard disk, sound card, and so forth ahead of time.

HANDLING COMPONENTS

- PROCESSOR** Most CPU upgrades are straightforward, but some require you to adjust motherboard jumpers or insert a daughtercard between the CPU socket and the new CPU.
- ☐ **KEEP YOUR NEW CPU** in its box until you're ready to install it.
- ☐ **PURCHASE A HEAT SINK** and a fan if your CPU upgrade kit does not come with either item.
- ☐ **DOWNLOAD DOCUMENTATION** from the manufacturer's Web site if you don't have a manual or a component map for your motherboard.
- HARD DISK** The most common hard disk upgrade adds a second IDE hard disk to the primary IDE connector. The boot drive needs to be configured as the "master" drive, and the other as a "slave."
- ☐ **PAY ATTENTION** to jumper settings, and make sure the drive cable is fitted correctly.
- ☐ **CHECK THAT** the drive manufacturer provides alternate jumper settings for today's larger hard disks. (Older motherboards' BIOSes cannot handle disk sizes above 2GB.)
- ☐ **DETERMINE WHETHER** you need to get an upgraded BIOS (check the Web) or if you can use a disk overlay program such as Disk Manager, which is included with most new drives.
- ☐ **MOUNT THE HARD DISK** securely, but don't overtighten screws.
- GRAPHICS CARD** A new graphics card may introduce conflicts to your current software. If this happens, you may need to switch to a generic driver, such as the basic Windows 95 VGA graphics driver. Once conflicts are resolved, reinstall the proper driver.

to a 60-Hz refresh rate (at 1,024-by-768 resolution). Your old monitor's size may be adequate, but even at 800-by-600 resolution, some monitors do not support the 75- to 120-Hz refresh rates that the new graphics cards can accommodate.

Our upgrade was still incomplete without memory and a CPU. You can reuse the DRAM from the original unit when speed ratings and interfaces are compatible, but with memory prices as low as they are, we added two 8MB EDO DRAM SIMMs from Kingston Technology (total, \$90

street). For optimum performance, complete banks of memory must be accessed. Two SIMMs are usually equal to one bank and so should be added in pairs. DIMMs may be added one at a time.

We acquired a Pentium MMX/233 from NEC Technology; the chip may be tagged at \$200 to \$350 on the street. (Intel does not sell them direct to retailers.) Most mail order vendors offer motherboard/CPU packages ranging from \$300 to \$600.

Both Socket 5 and Socket 7 consist of 296 pinholes arranged in a rectangular shape, with three sharp 90-degree corners and one noticeably notched corner.

Accordingly, the 296-pin rectangle of each Socket 7 CPU has a matching notched corner; simply line up the notches when installing. A zero insertion force (ZIF) socket, which helps pull down the CPU into the socket and fastens it there with a lever, facilitated the process.

Once we fitted our CPU with a cooling fan (a necessity that costs only a few dollars at any retailer), we checked the motherboard's jumper settings carefully. Disparate CPUs require disparate voltages and clock speeds; thus, you must set various motherboard jumpers on or off or risk parts damage. Check your motherboard manual for the correct settings.

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TEST RESULTS: 486 SYSTEM AND UPGRADES

Base system: 486DX2/66, 16MB of RAM, 256K L2 cache, 425MB EIDE hard disk, Diamond Viper VLB 2MB graphics card, 2X CD-ROM drive.

Note: We do not advise individual component upgrades on a 486-based system, since many new components use technology not supported on 486 motherboards.

Upgrade parts: Motherboard—ASUS Pentium MMX/233, 512K L2 cache (\$350); RAM—16MB RAM upgraded to 32MB (\$90); graphics—Diamond Stealth II 4MB SGRAM graphics card (\$120); disk—6.4GB IBM Ultra-ATA hard disk (\$300); CD-ROM—Toshiba 24X CD-ROM drive (\$100).

ZD BUSINESS WINSTONE 98

Base system	3.6
Upgraded to 32MB RAM (\$90)	4.0
Upgraded motherboard ¹ , 16MB RAM, with:	
Upgraded graphics (\$470)	10.5
Upgraded disk (\$650) ²	15.0
Upgraded graphics, disk, CD-ROM; 16-bit color (\$870)	15.1
Upgraded graphics, disk, CD-ROM; 32-bit color (\$870)	14.0
Upgraded motherboard ¹ , 32MB RAM, with:	
Upgraded graphics (\$560)	14.9
Upgraded disk (\$740) ²	17.7
Upgraded graphics, disk, CD-ROM; 16-bit color (\$960)	17.8
Upgraded graphics, disk, CD-ROM; 32-bit color (\$960)	16.9

BETTER ►

ZD GRAPHICS WINMARK 98

Base system	14
Upgraded motherboard, graphics (\$470)	86
Upgraded graphics, disk, CD-ROM; 16-bit color (\$870)	91
Upgraded graphics, disk, CD-ROM; 32-bit color (\$870)	70
Base system with RAM upgraded to 32MB (\$90)	14
Upgraded motherboard, graphics (\$560)	91
Upgraded graphics, disk, CD-ROM; 16-bit color (\$960)	93
Upgraded graphics, disk, CD-ROM; 32-bit color (\$960)	74

BETTER ►

ZD CPUMARK₃₂

Base system	78
Upgraded motherboard (\$350) ²	454
Base system with RAM upgraded to 32MB (\$90)	83
Upgraded motherboard, RAM (\$440) ²	470

BETTER ►

ZD DISK WINMARK 98 (thousands of bytes/sec)

Base system	379
Upgraded motherboard (\$350) ²	515
Upgraded disk, motherboard (\$650) ²	1,170
Original hard disk, upgraded RAM (\$90)	403
Upgraded motherboard, RAM (\$440) ²	534
Upgraded disk, motherboard, RAM (\$740) ²	1,250

BETTER ►

ZD CD-ROM WINMARK 98 (thousands of bytes/sec)

Base system	195
Upgraded motherboard (\$350) ²	225
Upgraded CD-ROM, motherboard (\$450) ²	1,390

BETTER ►

The original graphics card of the machine could not run our ZD 3D Winmark test; with the new graphics card and 32MB of RAM (the test requires 32MB or more to run), the machine scored 186.

(1) The new motherboard requires a new graphics card; all results are with a new graphics card. (2) Does not include the price of a new graphics card.

Our physical work was over, but we needed another hour or so to configure the system. When the unit booted, Windows 95 successfully found and configured most new components but failed to recognize the new PCI bus and, as a result, failed to see our new graphics card. Windows 95 had disabled our old graphics driver and installed a generic VGA version. To configure the ISA/PCI bridge and the PCI bus correctly, we loaded a patch from the Asus installation CD. Upon rebooting, our Stealth II card was recognized, and we could install its drivers from Diamond's bundled disk. We spent the rest of our time solving IRQ conflicts under Windows 95's Device Manager. This was the most difficult part of the upgrade.

486: DISK UPGRADE

With a new \$300 6.4GB Ultra ATA hard disk and a few additional hours of labor, we squeezed even more performance out of our erstwhile 486. For a total of \$850, the Winstone test score rose to 15 and was on a par with most any high-end Pentium/233. Disk performance was twice as high.

Such performance was higher than that of the new \$800 Hewlett-Packard Pavilion 3260 we tested for comparison purposes (the price does not include the monitor).

The HP 3260 (a Pentium MMX/200 CPU, 32MB of SDRAM, a 2.1GB IDE hard disk, a 32-bit graphics adapter with 1MB of memory, a 16X CD-ROM drive, and no L2 cache) scored 11.6 on our Winstone tests. The unit suffered primarily because it lacked L2 cache. The system includes a 56-Kbps modem and offers a much faster CD-ROM drive, but it does not offer 3-D graphics, and its performance was below that of our \$850 upgrade. Of course, by this point we had added nearly an entire new system: a motherboard, a CPU, memory, a disk, and a graphics card. If you are comfortable performing motherboard upgrades and can resolve IRQ conflicts with confidence, upgrading may be a cost-effective option for you. Note, however, that you would still be using some older components, such as the power supply and fan, which are more likely than others to suffer wear and tear.

To replace the 486's 425MB hard disk, we acquired a 6.4GB IBM Deskstar Ultra ATA disk. The Ultra ATA interface substantially improves hard disk performance, but you need a compliant chip set or an add-in controller card to take advantage of it. Though our Asus motherboard offered Ultra ATA support via Intel's 430TX chip set, not all mother-

boards do. If you lack such support, you'll still be able use an Ultra ATA drive, but your drive's maximum burst transfer rate will be 16.7 MBps, versus the 33 MBps you should be getting.

Before removing an old disk, you must first decide how to transfer your data onto the new one. You can stack the floppy disks; or those who have removable storage devices such as an Iomega Zip Drive (\$140 street) can back up and transfer data easily using that device's bundled software. Consider reinstalling Windows 95 and other software to get rid of all those applications you haven't used since the Bush administration. Be sure to create a Windows 95 boot disk before removing your existing disk, so you can start your PC once the new disk is installed. You may also opt to install your new disk before removing the old and use a program such as PowerQuest Corp.'s DriveCopy (\$30 street) to copy your old disk to the new disk exactly.

After we had unscrewed our old drive and detached its power and IDE connectors, we made the appropriate changes to jumper settings, inserted the new drive, and screwed it down. We reinserted our power and IDE cables, remembering that the colored stripe running down its edge must face the drive's power connector.

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BENCHMARK TESTS

PC Upgrades



Pentium-class PCs get better performance from upgrades such as faster OverDrive chips and more RAM. In a 486-class PC, you must replace your motherboard and add RAM for true performance enhancements.

What the Numbers Mean

ZD Business Winstone 98 Additional memory is fairly inexpensive and can benefit most systems. On the 486 platform, we saw an 11 percent increase in going from 16MB to 32MB; in the Pentium base system, we saw gains of up to 15 percent.

As expected, the motherboard upgrade yielded truly impressive improvements: With a Pentium MMX/233 and 16MB, the Winstone score nearly tripled compared with the 486 base PC; at 32MB of EDO DRAM, it more than quadrupled. New motherboard chip sets contribute to better performance, with support for EDO DRAM, Ultra ATA disks, and PCI bus mastering. The new board also had 512K of L2 cache, versus the 486's 256K. The 486 PC used an obsolete VESA graphics card, so we could not do a direct comparison with original components after the motherboard upgrade; we used the Diamond Stealth II card after the upgrade.

With a new Pentium II/266 motherboard and 32MB of RAM, the Winstone test score was nearly double that of the Pentium/100 PC. Performance would have been even better if we had been able to use a motherboard with the 440LX chip set, which supports faster SDRAM and Ultra ATA disks, instead of the 440FX chip set that came with our required Baby AT model.

We also upgraded the processor in our Pentium/100 base system. The 200-MHz Intel OverDrive CPU beat the 200-MHz Evergreen MxPro by 3 to 5 percent in all configurations. Given that the Ever-

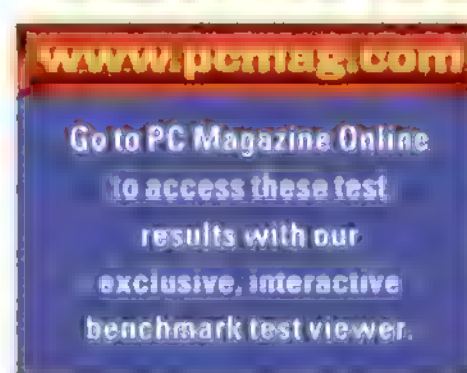
green product is only \$20 cheaper than Intel's OverDrive, we see little reason to opt for the MxPro. Both upgrade processors provided about a 50 percent Winstone boost at 32MB.

There was little additional performance benefit to a complete component upgrade. We saw an average of 3 percent.

ZD Graphics WinMark 98 With the new motherboard and card, the Graphics WinMark score was over six times as high as the base 486's score. The original card, based on the Weitek Power 9000 chip using the VL bus, cannot compare with the new Stealth II, based on the Rendition V2100 chip using the PCI bus.

In the Pentium/100 PC, results were different. The unit's original graphics card used the S3 ViRGE chip. This chip doesn't accelerate 3-D functions, but it is an able 2-D accelerator. The S3 bettered the Rendition V2100-based card by 8 to 10 percent on our 2-D tests.

ZD Disk WinMark 98 With the motherboard upgrade and a new



IBM Deskstar disk, performance tripled. This happened because the new motherboard's chip set supports the Ultra ATA IBM disk's 33.3-MBps data-transfer rate and because the new disk spins at 5,400 rpm versus the original's 3,314 rpm. The original IDE disk had a top throughput of 2 to 3 MBps; the new motherboard alone boosted the score by 30 percent.

In the Pentium/100 PC and with upgraded CPUs, the new disk improved performance by 26 percent. The Pentium II motherboard can't take advantage of the UltraDMA/33 mode, but the faster rotational speed of the IBM disk (the original disk had a speed of 5,200 rpm) and the IBM's magneto-resistive heads, which allow for a higher areal density, led to a 13 to 15 percent performance boost.

ZD 3D WinMark 98 The 486 used a graphics card with no 3-D support, so all test scenes had to run in software, making them painfully slow. After 24 hours on one test run, we stopped the test. With the new Diamond card in the Pentium MMX motherboard, the unit earned adequate scores for nondemanding 3-D games.

In the base Pentium/100, the Diamond card more than tripled 3-D performance. With the Intel OverDrive chip, which doubles L1 cache size and adds MMX technology, 3-D performance nearly

IBM bundles a utility—Disk Manager, from Ontrack Computer Systems—with its disk. (Most new disks come with some such utility.) Disk Manager first formats the disk, then installs a small BIOS patch. Thanks to the new motherboard, the PC's BIOS could handle the new 6.4GB disk on its own, but most BIOS revs from the 486 era cannot handle disks any larger than 2GB. The bundled disk utilities take care of the problem but introduce performance delays. You may want to flash your BIOS to update it (check the Web for the latest versions), but if that doesn't work, you'll have to call your manufacturer for help.

486: COMPLETE UPGRADE

A new CD-ROM drive (Toshiba's XM-6102B 24X model, \$85 to 100 street) raised the ZD CD-ROM WinMark test perfor-

mance score from 225 to 1,380. Installing a CD-ROM is like installing a hard disk—only it's simpler on the software side. After sliding the CD-ROM into a 5.25-inch bay and then connecting our power and IDE cables (paying attention to that colored stripe), we rebooted, and the new hardware was recognized automatically.

Once we'd added two more 8MB EDO SIMMs (another \$90) for a total of 32MB, performance rose on all other tests as well. The Winstone test score with 16-bit color went up to 17.8. At this point, we had added \$1,050 worth of hardware to our original 486 machine, rebuilding the unit. The HP 3260 is a few hundred dollars cheaper than our final 486 upgrade PC but is slower, has a smaller hard disk, and offers little room for expansion (one shared ISA/PCI slot and no empty drive bays). The unit's hard-

ware advantages are its bundled modem and better sound card. The new HP system also comes with a better warranty.

THE PENTIUM/100

We also upgraded a slightly younger model—a Micron Pentium/100, circa the summer of 1994. This modest PC was outfitted with 256K of L2 cache, 16MB of EDO DRAM, a 2.1GB hard disk, a Diamond Stealth 3D 2000 graphics card (2MB of EDO DRAM), a Creative Technology 8X CD-ROM, and a Creative Technology Vibra 16 audio card. Like the 486, the Micron unit lacked DIMM sockets, but unlike the 486, it benefited from a PCI bus.

We began our hardware improvements by adding fifth-generation upgrade CPUs, one from Intel, the other from Evergreen. After the installation of a single, sub-\$300

doubled compared with the Pentium/100 base; the same pattern held true with the OverDrive and the new card. The 3D WinMark tests also showed the WinChip-based Evergreen CPU's weakness. The WinChip's initial score was lower than that of the Pentium/100, as was the WinChip's score with the new card. The WinChip supports MMX extensions, but 3-D performance relies heavily on the CPU's floating-point unit; the WinChip forgoes an advanced FPU to keep the chip simpler and less expensive than a comparable Intel CPU.

Like the OverDrive CPU, the Pentium II has 32K of L1 cache and MMX support. Because of its faster core speed and enhanced pipeline, the 3D WinMark score was three times as high as the base unit's score with the new graphics card.

2D CPUmark₉₉ The new motherboard's Pentium MMX/233 and faster memory bus (66 MHz versus the original's 33 MHz) achieved more than five times the score of the 486 unit. In the Pentium/100, we saw CPU scores increase from 227 to 379 and 350 with the Intel OverDrive and Centaur WinChip, respectively. Performance nearly tripled with the Pentium II/266 motherboard.

2D CD-ROM WinMark 98 The 24X Toshiba CD-ROM drive performed as expected in both base systems. In the course of testing, however, we found that the original 8X Creative Technology drive from the Pentium/100 PC had one glaring peculiarity: After we upgraded the motherboard and reinstalled the original drive, we saw the unit's score actually drop lower than its score with the base system; the transfer rate on the inside tracks was down to 2X speeds. This 8X drive uses CLV technology, and the drive's read heads need to be able to read the data from the disk without any system delays. We suspect that the faster timings on the Pentium II motherboard are causing timing delays on the drive as it tries to keep up with the motherboard's requests.

How We Tested

We tested a 486 DX2/66-based unit and a Pentium/100-based PC, both with Windows 95. We stripped each PC's start-up configuration of all processes and tasks except Systray and Explorer, defragmented the hard disk before each test, and let Windows 95 manage virtual memory settings. We used the graphics driver provided by the vendor.

For the 486-based system, we tested the system after boosting memory to 32MB, then upgraded the motherboard and tested the

unit at both 16MB and 32MB with original components (replacing only the VL-based graphics card). The hard disk and the CD-ROM drive were then upgraded and tested individually. For the Pentium/100 system, we upgraded and individually tested the memory, hard disk, graphics card, and CD-ROM drive. Individual component upgrades were repeated in conjunction with Intel's Pentium/200 MMX OverDrive CPU, Evergreen's MxPro 200 CPU, and a Pentium II/266 motherboard upgrade; each was first tested with the Pentium/100's original components. Both the 486 and Pentium systems were finally tested with all components upgrades at 1,024-by-768 resolution with both 16-bit and 32-bit color.

2D Winstone 98 is divided into two parts: **2D Business Winstone 98** and **2D High-End Winstone 98**. We ran only our Business Winstone 98 tests, which measure the time a PC takes to execute each of a set of nine application scripts. The tests weight each PC's test timings based on the applications' unit market shares, derive a composite number, and convert that number to a relative score. (The score is relative to the performance of a Dell Dimension Pentium/133 with 32MB of RAM, at 1,024-by-768 resolution with 16-bit color, running Windows NT 4.0 with Service Pack 3. The base score is defined as 10.)

2D WinBench 98 measures a system's graphics, disk, processor, CD-ROM, full-motion video, and DirectDraw performance under Windows 95. We ran only the business portion of the best suite. The **Business Graphics WinMark 98** score is based on a log of GDI operations used in the Business Winstone 98. Scores are relative to those of the base system used for Winstone testing. The **2D Business Disk WinMark 98** score is based on a log of disk functions used in the Business Winstone suite. We record the results in thousands of bytes per second and convert them to a harmonic mean. We then weigh this mean in the same way as the Business Winstone 98 score.

The **2D CPUmark₉₉** emulates the CPU activity of real-world 32-bit applications. The **2D CD-ROM WinMark 98** tests are based on a profile of today's most popular Windows CD-ROMs.

The **2D 3D WinBench 98** is made up of the **3-D Quality** test, which determines which of 31 features the graphics card supports, and a performance portion of the test, which yields the **2D 3D WinMark 98** score. Each of 19 scenes is rendered by hardware if all 3-D options in the scene are supported; otherwise, the scene is rendered in software. Direct3D 5.0 was installed on each system before running the tests.

part, Winstone test results had improved by 35 to 40 percent—performance comparable to that of today's value-based Pentium MMX PCs. In fact, general performance bettered that of our HP 3260 on every test save the CD-ROM WinMark.

Intel's OverDrive CPU is now at 200 MHz and offers 32K of L1 cache and MMX technology for only \$300. Equipped with a voltage regulator and fan, the chip can be installed without jumper changes or additional software. It is compatible with any Socket 7 PC as well as many Socket 5 models (Intel's Web site, www.intel.com, has a list of compatible Socket 5 systems). Before installing the CPU, we checked our motherboard manual and our BIOS for compliance using Intel's installation disk.

Evergreen's MxPro upgrade, based on

Centaur Technology's IDT WinChip C6 CPU, sells for roughly \$20 less, but its Winstone performance is about 5 percent lower than that of the Intel OverDrive CPU.

Before replacing the Pentium/100's motherboard, we upgraded its hard disk, CD-ROM drive, memory, and graphics card—each separately—using the same components added to our 486. Of these other components, the upgrade to 32MB of memory provided the single biggest performance boost. Outfitted with \$910 of additional or replacement hardware (a hard disk, a 24X CD-ROM drive, a graphics card, 32MB of RAM, and an Intel 200-MHz MMX OverDrive CPU), our Pentium/100 scored 16.3 on the Business Winstone tests. This level of performance begins to rival that of the Dell Pentium II/233 unit (\$1,599 direct).

PENTIUM/100: NEW MOTHERBOARD

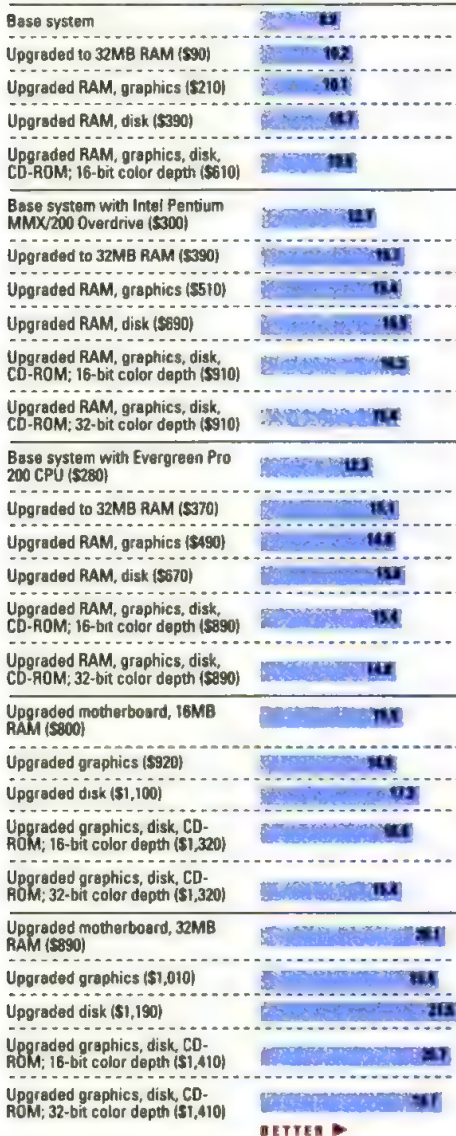
In order to outfit our Pentium/100 PC with a Pentium II CPU, we had to replace its motherboard. This time, we used the Tyan Tahoe AT S1680S, a Baby AT model available for \$400 at popular retail outlets. The Tahoe has Intel's 440FX chip set, 512K of L2 cache, four ISA slots, three PCI slots, and eight SIMM sockets. To this board we added a Pentium II/266 (which sells for between \$400 and \$600 from resellers) and saw the unit's Winstone test score rise only to 15.4. Performance improved to true Pentium II levels when we upgraded main memory to 32MB, for a total cost of \$890. The fully upgraded PC—equipped with \$1,410 of new hardware (motherboard, Pentium II, hard disk, graphics card, CD-ROM, and memory)—scored 19.7 under Business Winstone (with 32-bit color), a

TEST RESULTS: PENTIUM/100 SYSTEM AND UPGRADES

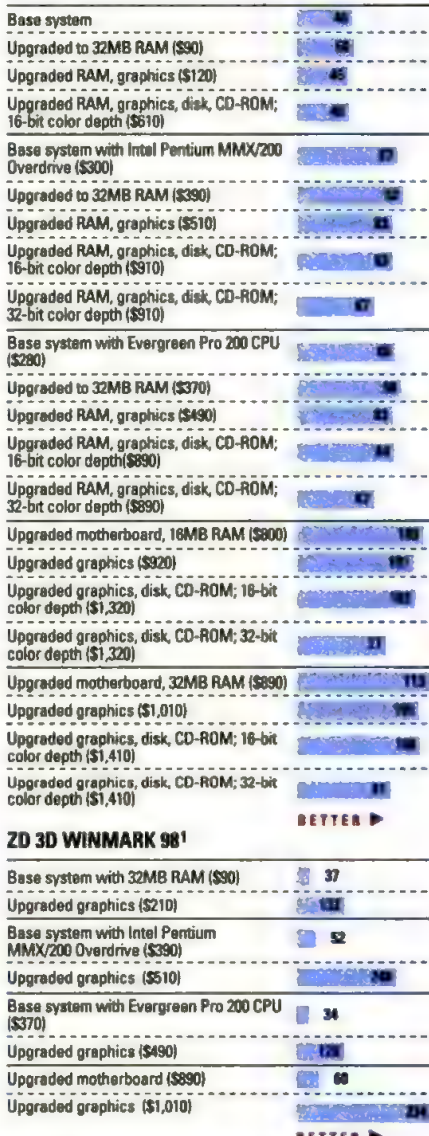
Base system: Pentium/100, 512K L2 cache, 16MB of EDO DRAM, 2.1GB EIDE hard disk, Diamond Stealth 3D 2000 2MB EDO DRAM PCI graphics card, 8X CD-ROM drive.

Upgrade parts: *Motherboard*—Tyan Tahoe with Pentium II/266 (\$800); *Intel Pentium MMX/200 Overdrive* (\$300); *Evergreen Pro 200 CPU* (\$280); *RAM*—16MB RAM upgraded to 32MB (\$90); *graphics*—Diamond Stealth II 4MB SGRAM graphics card (\$120); *disk*—6.4GB IBM Ultra ATA hard disk (\$300); *Toshiba 24X CD-ROM drive* (\$100).

ZD BUSINESS WINSTONE 98



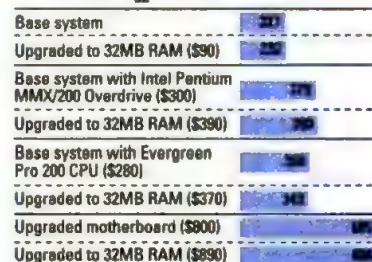
ZD GRAPHICS WINMARK 98



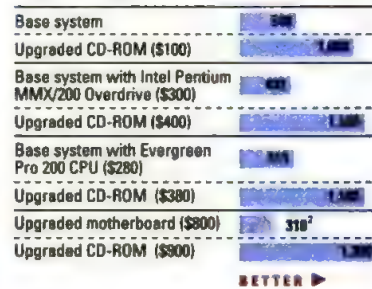
ZD DISK WINMARK 98 (thousands of bytes/sec)



ZD CPUMARK 32



ZD CD-ROM WINMARK 98 (thousands of bytes/sec)



(1) All pricing includes 32MB of RAM, necessary for this test. (2) Anomalous result, please see "What the Numbers Mean" for more information.

figure on a par with the 266-MHz systems tested for our issue of December 2, 1997 ("The Best PCs for '97 & '98"). Such performance is higher than that of both our new comparison systems but also carries a high price in labor and time for just \$150 in savings over the Dell unit. Also, by the time you read this, you should already be able to buy new Pentium IIs with new monitors for this price, and cacheless Pentium IIs are right around the corner, which should drop a basic Pentium II PC's price below \$1,000.

WHAT ABOUT MULTIMEDIA AND 3-D?

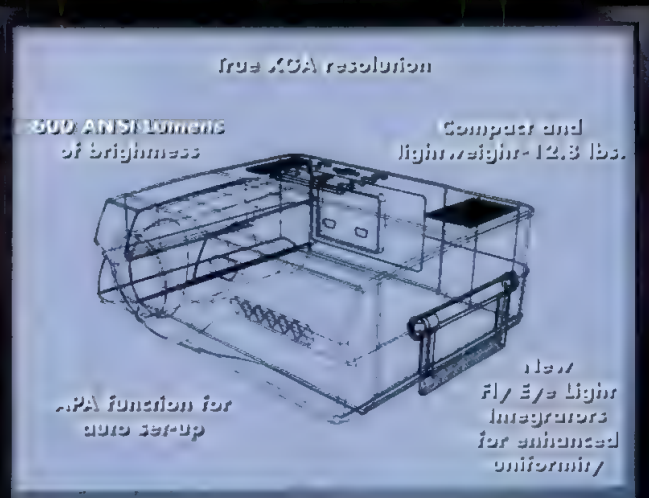
Whereas a new hard disk or a new CPU increases raw speed, devices such as DVD drives and audio cards provide qualitative benefits that are more difficult to measure. Better sound and speakers will improve your multimedia experience, a high-end 3-D card will improve gaming, a faster modem will help Internet access, and a DVD drive will allow you to watch movies and store more data per disk. The necessary hardware can be easily found at your local

retailer. We installed a \$379 PC-DVD Encore Dxr2 kit from Creative Labs, a \$200 Sound Blaster AWE-64 Gold card (also from Creative Labs), \$99 ACS45 speakers from Altec Lansing, and a \$219 internal x2 modem from U.S. Robotics (all prices are list). A 5-year-old chassis can hold a high-end Pentium II/266 with every of-the-moment multimedia peripheral, but this will cost \$2,207, sans monitor. Unless you have a fetish for motherboard upgrades, avoid the hassle. Call your favorite PC vendor. **PC**



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3D Performance Comparison - ZD 3D Winbench98

ATI XPERT@PLAY	
RAM AGP	540
RAM AGP	532
5TB Velocity 128	458
Diamond Viper 330	438
Diamond Monster 3D	383
Hercules Stringray 128	373
Matrox Mystique 220 / Matrox M3D	232
Matrox Millennium II	91.7
Creative Labs Graphics Blaster	72.2

ATI XPERT@PLAY	
GPU AGP	GPU AGP
GPU AGP	GPU AGP
STB Velocity 128	458
Diamond Viper 330	438
Diamond Monster 3D	383
Hercules Stringray 128	373
Matrox Mystique 220 / Matrox M3D	232
Matrox Millennium II	91.7
Creative Labs Graphics Blaster	72.2

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REMOVABLE STORAGE

BIG CAPACITY, SIZZLING SPEED

BY M. DAVID STONE

Removable mass storage has finally moved into the mainstream PC consciousness. Leading the charge has been Iomega, with an omnipresent TV ad campaign for its Zip product line. Press releases that read like the signs on the golden arches in the early days of McDonald's: "Over 11,000,000 sold. Only that's Zip Drives, not hamburgers."

Once a niche product for graphic artists who needed to send large files to service bureaus and for government agencies whose top-secret files needed to be locked up in a safe overnight, removable

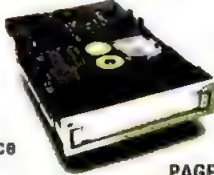


DRIVE FINDER Matching the Drive to the Job at Hand

The removable drives we tested have different strengths (and weaknesses) and are suited to varying tasks. We've identified eight primary functions for a removable drive, along with the drives we feel are best for each chore.

BACK UP YOUR ENTIRE HARD DISK

Key considerations: Capacity and, to a lesser extent, speed. Ideally, you'll want to fit an entire backup on a single piece of media.



PAGE

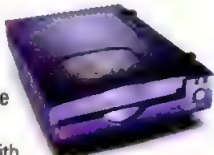
BEST BET: Seagate TapeStor Travan169

Runners-up:

Iomega DittoMax164
Iomega Jaz 2GB164
Summatec MobileDrive178
SyQuest SparQ178
SyQuest SyJet178

BACK UP SELECTED FILES

Key considerations: Convenience, speed, cost. You can pick a handy parallel-port drive that you can shuttle between PCs or take with you on the road. Being able to share the media with others is a plus.



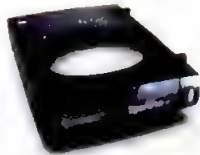
BEST BET: SyQuest SparQ178

Runners-up:

Avatar Shark 250159
HP SureStore CD-Writer Plus160
Imation SuperDisk161
Iomega ZipPlus164
SyQuest EZFlyer 230178

MOVE DATA AND APPLICATIONS OFF YOUR HARD DISK

Key considerations: Capacity, performance. To create near-line storage for large files and directories that you need to access fairly often but



may be clogging your primary hard disk (digital photos and scans, for example), you need a drive that holds a lot but stores and retrieves quickly.

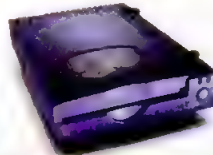
BEST BET: SyQuest SparQ178

Runners-up:

HP SureStore CD-Writer Plus160
Iomega Jaz 2GB164
Summatec Mobile Drive178
SyQuest SyJet178

SHARE FILES THAT ARE TOO BIG FOR A FLOPPY DISK

Key considerations: Popularity. Take a close look at drives aimed to become the new standard for this function.



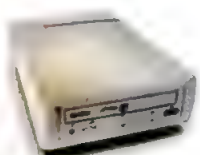
BEST BET: Iomega ZipPlus164

Runners-up:

HP SureStore CD-Writer Plus160
Imation SuperDisk161

DISTRIBUTE DATA TO OTHERS

Key considerations: Popularity, low storage costs. You want to be sure all the people on your distribution list have drives that can read the disk. And since you won't be getting the disk back, it needs to be cheap.



BEST BET: HP SureStore CD-Writer Plus160

Runner-up:

Iomega ZipPlus164

SHUTTLE FILES BETWEEN HOME AND OFFICE

Key considerations: Low drive cost. Since you don't want to carry a



drive back and forth, just the media, you want an inexpensive drive you can have at both locations.

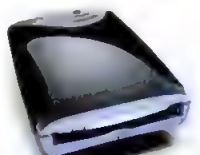
BEST BET: Imation SuperDisk (or a built-in LS-120 in a new PC)161

Runners-up:

Iomega ZipPlus164
SyQuest EZFlyer178

DRIVE TO TAKE ON THE ROAD

Key considerations: Portability, capacity. Several drives come in lightweight external models that hook to the parallel port. If you need to transport large presentations, be sure to pick a drive with adequate capacity and good performance.



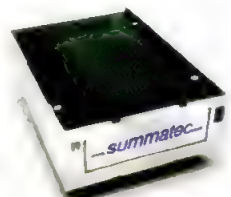
BEST BET: Avatar Shark 250159

Runners-up:

Iomega ZipPlus164
SyQuest EZFlyer178

SUPPLEMENT YOUR HARD DISK

Key considerations: Speed, capacity. You need a device with near-hard disk performance so you can run applications. Such a drive will also let you have distinct "drives" for different OSs or to keep your data and applications separate from your teenager's.



BEST BET: Summatec MobileDrive178

Runners-up:

Iomega Jaz 2GB164
SyQuest SparQ178
SyQuest SyJet178

drives are becoming standard issue on PCs—and are one of the most popular add-ons at the retail level.

Why? There are three reasons. First, the 1.44MB floppy disk has long outlived its usefulness for storing, transporting, or sharing PC files; its capacity is simply inadequate. Second, hard disk space is valuable, and with Internet downloads, scanned images, and digital photos being added to your core set of applications, utilities, and games, you need somewhere to put your stuff (to borrow from the Zip campaign). And third, for the first time you can find removable drives whose performance and capacities—1GB and above—approach

hard disk levels at prices that aren't much higher than those you'd pay for a hard disk.

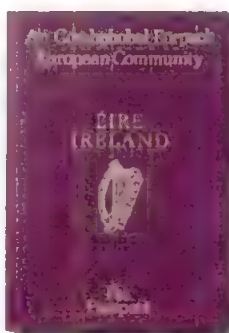
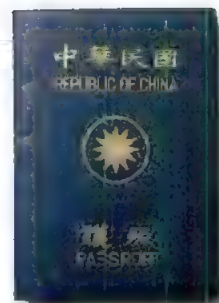
REVIEW CRITERIA

For this story PC Labs tested the full range of desktop storage devices:

- All the disk-based removable drives new to the market since our roundup of a year ago ("Unlimited Options," May 6, 1997), along with past Editors' Choice honorees.
- One representative CD-RW drive, from Hewlett-Packard. (Our recent roundup of 24 recordable-compact disk drives appeared in our issue of March 10, 1998, and can also be found online at www.pcmag.com.) We chose to include

the HP SureStore CD-Writer Plus 7200e here because it hooks up to the parallel port, which will appeal to many users, and because this new HP drive delivers the most complete end-user software bundle.

- Representative tape drives from Iomega Corp. and Seagate Technology, two of the largest vendors of personal tape drives.
- Three representative magneto-optical (MO) drives, from Maxoptix, Pinnacle Micro, and Verbatim/Mitsubishi (see the sidebar "MO Drives: Solid Technology That Costs Too Much").
- Traditional fixed hard disks from the five largest vendors, for users who simply want more space without removability (see "A



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Second Hard Disk: Fast and Economical").

Most of the drives here use magnetic technology to store data on either a floppy disk or a removable hard disk cartridge, much as standard floppy and hard disks do. They record data as magnetized areas on the disk. The exception among the main reviews in this roundup is the HP SureStore, a CD-RW (compact disk-rewritable) drive: It employs phase-change technology, in which a laser heats the recording layer to change the structure between crystalline and noncrystalline states.

With so much variation in the field, it helps to divide the offerings into categories based on capacity rather than technology.

FIVE FLOPPY-CLASS DRIVES

Five of the drives we tested—the Avatar Shark 250 Mobile Hard Drive, HP SureStore CD-Writer Plus 7200e, Imation SuperDisk Parallel Port Drive, Iomega ZipPlus, and SyQuest EZFlyer 230 MB—could be considered floppy-class drives. Three of these—the HP SureStore, Imation SuperDisk, and Iomega ZipPlus—were specifically developed to replace floppy disks as the next industry-wide standard for transporting or sharing files.

The Avatar Shark 250 Mobile Hard Drive (\$250 street) stores 250MB of data on its proprietary magnetic cartridges. It is aimed primarily at mobile notebook users: The drive and cables weigh less than a pound, and you can get it with either a parallel-port interface or a cable that plugs into the PC Card slot. A handful of laptop vendors, including Fujitsu PC Corp. and Unisys Corp., offer the drive as a swap-in module option. Performance is adequate for a removable drive, though the drive isn't fast enough to play multimedia video clips.

The HP SureStore CD-Writer Plus 7200e (\$610 list) can create 650MB CD-RW and CD-R disks. If you use the drive to create CD-R disks, they can be read in nearly any CD-ROM drive—a boon if you need to distribute data and images.

Our Contributors: BRUCE BROWN, ALFRED POOR, WINN L. ROSCH, and M. DAVID STONE are contributing editors of *PC Magazine*. S. JAE YANG was the project leader, and senior associate editor JAMIE M. BSALES was in charge of this story.

EDITORS' CHOICE

- Iomega ZipPlus
- SyQuest SparQ 1.0 GB



In the wide-ranging field of removable storage drives, there are several solid choices and two stand-outs among the 14 drives we tested.

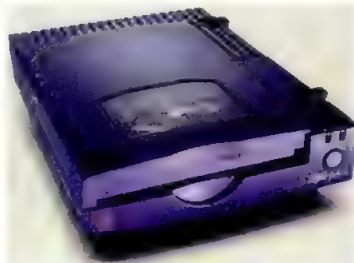
The 100MB Iomega ZipPlus, from Iomega Corp., isn't the fastest drive, nor the one with the most capacity, nor the most economical (\$200 street for the external drive, 13 cents per megabyte for cartridges). But this Editors' Choice delivers the right combination of ease of use and portability to make it ideal for a range of tasks, from shuttling files between home and office to taking data on the road. And with 11 million drives sold and counting, the Zip line of drives is the closest thing to a de facto standard for augmenting your floppy disk drive. So if you need to share files with other PC users (one of the biggest jobs of a removable drive), it's fairly likely they will have a Zip Drive, or have access to one. If you are buying a new PC, you certainly want to opt to have a Zip installed (typically a \$99 upgrade). If you are adding a drive to your present PC, ask around; if there are Zip users in your circle, you'll have your answer.

Our other Editors' Choice, the SyQuest SparQ 1.0 GB, from SyQuest Technology, is a cutting-edge drive that offers the best price/performance mix on the market today. It's fast (one of the best performers on our suite of speed tests), capacious (1GB per car-

tridge), and affordable (\$199 list for the drive, and \$33 for a cartridge—or just 3 cents per megabyte). The drive is available both in a parallel-port model (for portability and easy installation) and as an internal EIDE drive (to augment your primary hard disk). SyQuest has leap-frogged the competition (and its own products) with the SparQ; it is truly a breakthrough product.

One of the products in the SparQ's shadow is SyQuest's own SyQuest SyJet 1.5 GB (\$299 list and \$66 per cartridge, or 4 cents per megabyte), a past Editors' Choice winner that is still worthy of your attention and merits an honorable mention in this roundup. The SyJet is a rival for the SparQ in terms of speed, and the external SCSI model is a good choice for power users.

One other drive is worth noting. The Avatar Shark 250 Mobile Hard Drive (\$250 street and \$39 per cartridge, or 13 cents per megabyte) is a good choice for mobile users. This 250MB drive weighs about a pound (including cables) and can connect to your laptop's parallel port or PC Card slot. It offers 2.5 times the capacity of the ZipPlus for just a small price premium.



The Iomega ZipPlus combines the best ease, portability, and popularity.



The SyQuest SparQ drive marks a price/performance breakthrough.

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PC
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June 10, 1997
Lexmark Optra S 1250
Lexmark Optra S 1650



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Removable Storage

And this type of storage is cheap: CD-R disks can be purchased for \$4 apiece or less, which makes storage costs less than a penny per megabyte.

CD-RW disks (typically \$14 apiece) can be read by any CD-RW drive or MultiRead-compatible CD-ROM or DVD drive. The disks (which can be overwritten up to 1,000 times) are ideal for personal backups. Alas, CD-RW drives deliver slower performance than most other removables.

The Imation SuperDisk Parallel Port Drive (\$149.99 list) employs the LS-120 technology pioneered by Compaq, Imation (at the time part of 3M), and Panasonic. This dual-purpose drive can read from and write to standard 3.5-inch 1.44MB floppy disks; it can also work with the new 120MB LS-120 disks, which can be used in any LS-120 drive. The SuperDisk is an external parallel-port drive; other types of LS-120 drives are available from other manufacturers. Supporters of LS-120 technology are trying to make it the replacement for the floppy disk drive in PCs, and many PC vendors now offer LS-120 drives as an upgrade option in new desktops and laptops.

The Iomega ZipPlus (\$199 list) is the most popular removable storage device after the floppy disk. Although other drives offer better capacity and performance for the price (notably the new

SyQuest SparQ 1.0 GB from SyQuest Technology), the ZipPlus is appealing because of its convenience and popularity: Since so many PC users now have drives from the Zip line, it's a good tool for data sharing.

The SyQuest EZFlyer 230 MB (\$150 street) is an intriguing product without a definite future. It stores 230MB of data on its proprietary magnetic cartridges and can read from and write to the cartridges of its predecessor (the SyQuest EZ135 Drive). SyQuest, however, sees its future in what it calls the consumer desktop market, with the excellent new SyQuest SparQ (an Editors' Choice in this roundup). Though SyQuest will continue to provide EZ Flyer users with technical support and media, the company freely admits that the SparQ is the better buy.

FOUR HARD DISKS

Four of the tested drives—the Iomega Jaz 2GB, Summatec MobileDrive, SyQuest SparQ, and SyQuest SyJet 1.5 GB—can serve as complements to your primary hard disk, or even as replacements for it. They offer good capacity and excellent speed, making them suitable for storing lots of large directories or even entire applications (or operating systems).

The Iomega Jaz 2GB (external version, \$649 list; internal version, \$549) delivers 2GB of storage on each \$149.95

magnetic cartridge. Performance, alas, is the worst of the high-capacity drives (1GB and up). Note that Iomega sees this as its offering for power users; the original 1GB Jaz Drive (\$299 external, \$279 internal), which we reviewed a year ago, is still available and is a more economical choice for typical users.

The Summatec MobileDrive (\$120 for the docking station, \$260 for a 2.1GB cartridge) is a removable drive with a twist: Instead of just popping out a cartridge, you remove the entire drive mechanism. An EIDE docking station fits into a standard 5.25-inch drive bay on your PC, and Summatec sells 2.5-inch-form-factor hard disks (the kind used in laptops) housed in special cases that you can pop in and out of the bay. Capacities range from 2.1GB to 5GB. Performance is comparable to that of your hard disk, making the MobileDrive ideal for dual-OS PCs or for locking your data away at night.

The SyQuest SparQ 1.0 GB (\$200 street) offers the best bang for the buck in this roundup. Aimed at mainstream desktop users, the SparQ costs the same as the ZipPlus but holds ten times as much data on its \$33 cartridges, making it very affordable on a cost-per-megabyte basis (3 cents, versus 13 cents for the ZipPlus). It was also one of the fastest drives we tested in this roundup.

Pushed into the SparQ's shadow but

SUITABILITY TO TASK



Avatar Shark 250 Mobile Hard Drive



HP SureStore CD-Writer Plus 7200e



Imation SuperDisk Parallel Port Drive



Iomega DittoMax



Iomega Jaz 2GB

	Avatar Shark 250 Mobile Hard Drive	HP SureStore CD-Writer Plus 7200e	Imation SuperDisk Parallel Port Drive	Iomega DittoMax	Iomega Jaz 2GB
Backup and restore	Fair	Good	Fair	Excellent	Good
Data sharing and transport	Good	Excellent	Good	Good	Good
Hard disk complement	Fair	Poor	Poor	Poor	Excellent
Compatibility	Poor	Excellent	Excellent	Good	Fair
Speed	Good	Fair	Fair	Poor	Excellent
Drive price (external)	\$250 street	\$610.00 list	\$149.99 list	\$199.00 list	\$649.00 list
Capacity	250MB	650MB	120MB	1.5GB–3.5GB (native)	2GB
Media price (list)	\$39.00	\$4.00	\$14.00	\$20.00–\$30.00	\$169.95
Cost per megabyte	16 cents	0.6 cents	12 cents	0.8–1.3 cents	8 cents

To be well suited for **backup and restore**, a drive should include backup software that lets you back up system and hidden files. A better rating indicates that the drive has adequate capacity for full (or at least substantial) hard disk backups and a reasonable cost per megabyte for the media cartridges. The software should let you specify scheduled backups, partial backups, and other options easily.

To rate well in **data sharing and transport**, a drive should be popular with PC users and service bureaus, so you can send a disk with reasonable confidence that the recipient's setup will be able to read it. Portability is a plus, and a drive should be easy to connect and disconnect via the parallel or PC Card port. In addition, the drive and media should be fairly rugged to withstand life on the road.

PERIPHERALS

Removable Storage

still worthy in its own right is the SyQuest SyJet 1.5 GB (\$300 street). This drive stores 1.5GB of data on its \$66 cartridges and also offers excellent performance. It's the better choice for power users, thanks to its internal and external SCSI configurations.

DON'T FORGET TAPE

For many users, the best removable storage solution may be an old standard: the tape drive. Tape is the obvious choice for full-scale backups, thanks to its large capacity (up to 4GB without compression for the drives included here) and low cost per megabyte (a bit less than a penny for the drives included here). But tape has one serious drawback: slow speed. Throughput is inherently slower for tape technologies than for disks, and you have to wait while the drive winds through the tape to find a file.

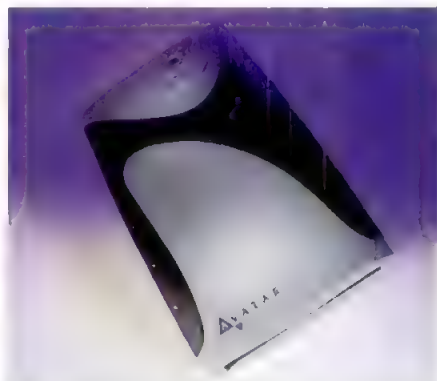
The world of removable storage is more varied than ever. So although making the right choice may be tougher, at least you're assured that there probably is a right choice to find. You'll certainly find more in-depth information on all of the drives in the reviews that follow.

Avatar Shark 250

Compact, lightweight, speedy, and easy to install, the mid-capacity Avatar Shark 250 Mobile Hard Drive, from Avatar

Peripherals, is a 250MB magnetic drive aimed squarely at portable PC users. Available in either a parallel-port or a PC Card version (each \$250 street, minus a \$50 mail-in rebate available through July 1998), the Shark 250 is a welcome companion for data backup and transport and as a secondary hard disk. The drive is also sold as a slide-in, modular option by notebook vendors, including Fujitsu and Unisys.

Both the PC Card and parallel-port models are identical, weighing just under 10 ounces each; the cables add 4 ounces. Though the drives and the media are



The lightweight Avatar Shark 250 is an excellent choice for mobile consumers.

designed to be portable, Avatar warns that transporting the drive with the media could damage them both. At 13 cents per megabyte (the cartridges cost

\$39 in single packs or \$99 for three), the Shark 250 media are priced competitively with the media of other portable drives such as the ZipPlus.

Installing the Shark 250 drives was easy. The PC Card version gains the power it needs from its single PCMCIA connection, but the parallel-port version requires a keyboard pass-through or mouse port. Unlike other drives in this roundup, Avatar's includes a host of software, including Blaze Technologies' animated greeting-card maker Barking Card, DocuMagix's Web page organizer HotPage Plus, McAfee virus protection, and NovaStor's backup utility NovaDisk Lite, as well as file-encryption software.

In our labs, the PC Card version was a better performer than the parallel-port model, but both consistently performed in the average range among tested drives on most backup, restore, and file-copying tasks. They had much lower data-transfer rates than other drives, however (notably the Iomega Jaz and SyQuest EZFlyer and SyJet). And neither was fast enough to play multimedia video files. But for portable backup and data-transfer tasks, the versatile Shark 250 is a good complement to your laptop.

—Bruce Brown

Avatar Shark 250 Mobile Hard Drive. Street price: \$250. Avatar Peripherals Inc., Milpitas, CA; 888-462-8282, 408-321-0110;

EDITOR'S CHOICE



Iomega ZipPlus



Seagate TapeStor Travan 8GB



Summtec MobileDrive



SyQuest EZFlyer 230 MB

EDITOR'S CHOICE



SyQuest SparQ 1.0 GB



SyQuest SyJet 1.5 GB

Fair	Excellent	Excellent	Fair	Excellent	Excellent
Excellent	Poor	Fair	Good	Good	Good
Poor	Poor	Excellent	Fair	Excellent	Excellent
Excellent	Good	Poor	Fair	Poor	Poor
Fair	Poor	Excellent	Good	Excellent	Excellent
\$199.95 list	\$530 street	\$240 street	\$150 street	\$200 street	\$300 street
100MB	4GB (native)	2.1GB-5GB	230MB	1GB	1.5GB
\$14.95	\$35.00	\$260.00-\$720.00	\$20.00	\$33.00	\$66.00
15 cents	0.9 cents	12-14 cents	9 cents	3 cents	4 cents

To be a good **hard disk complement**, a removable drive has to have the capacity to store large applications and their associated data files. It must have the performance to let you run applications and play video clips smoothly directly from the drive. The best drives on this task are bootable devices that let you keep an entire operating environment on a single cartridge.

A higher rating in **compatibility** indicates that a drive can read (or better, read and write)

other types of media formats besides its own cartridges. A favorable rating here may also indicate that a drive is backward-compatible with previous generations of that technology.

The **speed** rating indicates how fast overall a drive is for typical write and read tasks. An **excellent** rating indicates the drive is as fast as a typical fixed hard disk, or nearly so. A **poor** rating indicates that the unit's speed is comparable to that of a floppy disk drive or a tape drive.

Removable Storage

www.goavatar.com. Choose 501 at www.pcmag.com/infolink.

HP SureStore CD-Writer Plus

There's not much that you can't do with the new HP SureStore CD-Writer Plus 7200e, thanks to the kitchen-sink bundle of storage applications that come with this external CD-RW drive. It can store 650MB of data on either CD-RW or CD-R media and can also be used as a standard CD-ROM reader. With a hefty price

(\$610 list; EIDE version, \$499), this product from Hewlett-Packard Co. is more expensive and slower than other non-CD storage devices. But the extra versatility of recordable CD and the convenient parallel-port installation may be worth the additional cost for business and SOHO users.

The real allure of recordable CD technology is its capability of producing CD-ROM and audio CD disks that can be read by virtually any CD player in

existence. HP helps you take advantage of this by bundling a long list of current-version software, including Adobe PhotoDeluxe, Corel Print House Magic, DocuMagix's PaperMaster Live, EasyPhoto, the HP backup utility SimpleTrax, and Norton AntiVirus, as well as Adaptec's CD creation utilities—Audio CD, Direct CD, and Easy CD Creator. In short, you get ample software for a variety of home and office data-storage projects.

SUMMARY OF FEATURES

Removable Storage

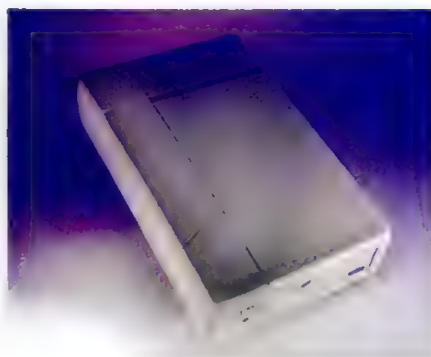
	Avatar Shark 750 Mobile Hard Drive	HP SureStore CD-Writer Plus 7200e	Imation SuperDisk Parallel Port Drive	Iomega DittoMax	Iomega Jaz 2GB	 Iomega ZipPlus	Seagate TapeStor Travan 8GB	Summatec MobileDrive
■ YES ... NO								
Price of internal/external configurations	N/A / \$250 street	\$499.00 / \$610.00 list	N/A / \$149.99 list	\$199.00 / \$199.00 list	\$549.00 / \$649.00 list	N/A / \$199.95 list	\$390 / \$530 street	\$120 / \$240 street
Weight of external unit	0.6 pounds	4.7 pounds	2.5 pounds	1.5 pounds	2.0 pounds	1.0 pounds	2.0 pounds	2.5 pounds
Dimensions of external unit (HWD, in inches)	1.0 x 3.5 x 5.5	2.6 x 7.1 x 11.2	1.6 x 5.9 x 8.3	1.8 x 5.5 x 8.8	1.5 x 5.3 x 8.0	1.0 x 4.0 x 6.4	2.0 x 6.0 x 9.3	1.8 x 5.9 x 10.6
Interface types tested	Parallel, PC Card	Parallel	Parallel	Parallel	SCSI	Parallel, SCSI	SCSI	EIDE
Other interfaces available	EIDE ¹	EIDE	EIDE, SCSI ²	None	Parallel	None	EIDE	Parallel
Other compatible formats	None	CD-R, CD-ROM	1.44MB floppy disks	Travan TR-3 tape	Jaz 1GB	None	All Travan tape	None
Formatted capacity	250MB	650MB	120MB	1.5GB–3.5GB ³	2GB	100MB	4GB ³	2.1GB–5GB
List price for media	\$39.00	CD-RW, \$14.00; CD-R, \$4.00	\$14.00	1.5GB, \$20.00; 2.5GB, \$26.00; 3.5GB, \$30.00	\$169.95	\$14.95	\$35.00	2.1GB, \$260.00; 3GB, \$397.00; 4GB, \$575.00; 5GB, \$720.00
Storage cost per megabyte	16 cents	CD-RW, 4 cents; CD-R, 0.6 cents	12 cents	0.8–1.3 cents	8 cents	15 cents	0.9 cents	12–14 cents
Data buffer size on drive	128K	1MB	128K	None	512K	32K	512K	128K
Claimed average access time/seek time	12 ms / 12 ms	32 ms / 32 ms	Not rated / 70 ms	Not rated	16 ms / 11 ms	29 ms / 29 ms	Not rated	9 ms / 13 ms
Claimed average sustained write rate	1,250 Kbps	300 KBps	290 KBps	Not rated	7,350 KBps	1,100 KBps	600 KBps	3,300 KBps
Claimed average sustained read rate	1,250 Kbps	175 KBps	290 KBps	Not rated	7,350 KBps	1,100 KBps	600 KBps	3,300 KBps
Verifies read after write	■	■	■	■	■	■	■	■
Bad-sector reallocation on write	■	■	■	■	■	■	■	■
Rated mean time between failures (hours)	100,000	100,000	15,000	200,000	250,000	100,000	350,000	300,000
Rated read-write cycles for media	Unlimited	1,200	Unlimited	5,000	Not rated	Not rated	Not rated	Unlimited
Estimated life of data on media	10 years	100 years	30 years	10 years	10 years	10 years	10,000 passes	10 years
Data recovery service for damaged media	■	■	■	■	■	■	■	■
Drivers available:								
Windows 95 / 3.x / NT	■ ■ ■ ■	■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
OS/2 / DOS	■ ■	■	■	■	■	■ ■	■ ■	■ ■
Macintosh-compatible	■	■	■	■	■	■	■	■
Can be used as a boot drive	■	■	■	■	■	■	■	■
Backup software included	NovaDisk Light Backup	HP Simple Trax	None	Iomega Ditto Tools	Iomega Jaz Tools	Iomega Zip Tools	Seagate Backup Exec	None
Caching software	■	■	■	■	■	■	■	■
Other software utilities included	McAfee Web-Scan, McAfee PCCrypto, others	Direct-CD, Easy-CD Creator, Easy-CD Audio, Photo-Deluxe, others	None	1-Step Copy, Scheduler, others	AppMover, Find It, Guest, others	PhotoDeluxe, Web Buddy, RecordIt, others	None	None
Warranty	1 year	1 year	1 year	2 years	1 year	1 year	2 years	2 years
Toll-free technical support included	■	■	■	■	■	■	■	■
Cost for technical-support call	Free	25 cents per minute up to \$25	Free	\$14.99 per call	Free	\$14.99 per call	Free	Free
Live technical-support hours (eastern time)	9:00–9:00 M–F	8:00–8:00 M–F	8:00–8:00 M–F	7:00 A.M.–10:00 P.M. M–F, 8:00–3:00 Sat.	7:00 A.M.–10:00 P.M. M–F, 8:00–3:00 Sat.	7:00 A.M.–10:00 P.M. M–F, 8:00–3:00 Sat.	9:00–7:00 M–F	1:00–8:00 P.M. M–F
Web site	www.goavatar.com	www.hp.com	www.superdisk.com	www.iomega.com	www.iomega.com	www.iomega.com	www.seagate.com	www.summatec.com

N/A—Not applicable: This product is not available in an internal configuration. (1) Available only in third-party laptops. (2) Available only from third-party vendors. (3) Native formatted capacity, without compression.

PERIPHERALS

Removable Storage

The drive is also easy to use. It has a parallel-port connection and includes a hot-swap utility that lets you connect and disconnect without rebooting, which can be handy when you want to use the drive with different computers. It writes data at 2X speed (300 Kbps) and can read CD media at 6X (900 Kbps). The drive is very attractive on a cost-per-megabyte basis: CD-RW storage costs about 4 cents per megabyte (the \$14 disks are reusable up to 1,000 times), and you can



Universal CD compatibility makes HP's SureStore a good choice for file sharing.

also use CD-R media (\$4 street, or less than 1 cent per megabyte) for disks you plan to distribute.

The caveat: CD-RW is not as fast as magnetic-media technologies for write operations, and our unit's parallel-port connection, though convenient, didn't help. This drive was much slower than average on our tests. For instance, it took 5 minutes 45 seconds to complete our 80MB Backup test; most other drives took 2 minutes or less. The internal EIDE version should prove faster, however, and the SureStore turned in acceptable times for read operations.

If you don't need blazing speed, the SureStore should be on your short list. The drive's high initial cost is offset by low media costs, and the ability to produce disks that can be read on any PC with a CD-ROM drive is an invaluable asset.—*Alfred Poor*

HP SureStore CD-Writer Plus 7200e. List price: \$610; EIDE version, \$499. Hewlett-Packard Co., Loveland, CO; 800-810-0134, 970-635-6801; www.hp.com/go/cdr. Choose 502 at www.pcmag.com/infolink.

Imation SuperDisk

The search continues for a replacement for the 1.44MB floppy disk, and the LS-120 drive is still a contender. Such drives, available from several PC and after-market vendors, can read or write standard floppy disks as well as special 3.5-inch disks that hold 120MB. These have been used as floppy disk replacements in new desktop and laptop drives. Those looking to add one to an existing system can look to the Imation SuperDisk Parallel Port Drive (\$149 list, minus a \$50 rebate available indefinitely), which is as easy to install as plugging in a printer.

ly), which is as easy to install as plugging in a printer.

Though the technology is faster than that of a standard floppy disk, it is still relatively slow. To speed up write times, the SuperDisk Drive comes with SuperDisk Accelerator software for Windows 95, which spools data writes to the system's hard disk. Your computer then acts as if the transfer were complete, even though it may take a few minutes to finish in the background while you continue working.

This spooling does boost performance—but not without a cost. You can't remove the disk until the write procedures are complete, of course, and the documentation warns against trying to send a print job to a printer connected to the parallel-port pass-through connector while data is being spooled to the drive. Without the spooling feature enabled, the



Newer rivals overshadow the Imation SuperDisk as a floppy disk replacement.

SuperDisk Drive was the slowest unit we tested in this roundup. With the feature running, apparent write times were cut in half, but it still scored in the below-average range.

Note, too, that a competitor looms on the horizon: The Sony HiFD drive is also compatible with 3.5-inch floppy disks but can store 200MB on its special disks (see the sidebar "Future Drives: Are They Worth Waiting For?"). The SuperDisk Drive is a good product, and as the company points out, it is available and affordable now. If you order it installed in a new PC for a small price delta over a standard floppy disk drive, it may be all you need. But if you're adding an external drive to an existing system, we recommend you opt for one of the more speedy (SparQ), capacious (SyJet), or popular (Zip) alternatives.—*AP*

PC MAGAZINE
EDITOR'S CHOICE

Syquest EZFlyer 230 MB	Syquest SparQ 1.0 GB	Syquest SyJet 1.5 GB
N/A / \$150 street	\$200 / \$200 street	\$300 / \$300 street
15 pounds	15 pounds	15 pounds
1.5 x 5.5 x 7.3	1.5 x 5.5 x 7.3	1.5 x 5.5 x 7.3
SCSI	Parallel, EIDE	Parallel, SCSI
Parallel EIDE	None	EIDE
EZ Flyer 135MB	None	None
230MB	1GB	1.5GB
\$20.00	\$33.00	\$66.00
9 cents	3 cents	4 cents
256K	612K	512K
18 ms / 13 ms	17 ms / 12 ms	17 ms / 12 ms
Not rated	Not rated	Not rated
Not rated	Not rated	Not rated
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
200,000	250,000	250,000
Not rated	Not rated	Not rated
5-10 years	5-10 years	5-10 years
■	■	■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
Syquest SyBack	Syquest EZ-Backup	Syquest EZ-Backup
■	■	■
None	Visit95	Syquest EZ-Recover
1 year	1 year	1 year
■	■	■
First call free, then \$15 per call	First call free, then \$15 per call	First call free, then \$15 per call
8:00 A.M.-10:00 P.M. M-F	8:00 A.M.-10:00 P.M. M-F	8:00 A.M.-10:00 P.M. M-F
www.syquest.com	www.syquest.com	www.syquest.com

PERFORMANCE TESTS

Removable Storage



While the EIDE-based Summatec MobileDrive and SyQuest SparQ both live up to the title "hard disk complement," fast floppy disk replacements like the Avatar Shark 250 and the SyQuest EZFlyer show that there's speed at the lower end of the spectrum.

What the Numbers Mean

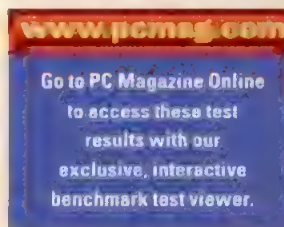
The 14 drives we tested break out into three categories based on variations in their capacity, performance, and design: floppy disk replacements (the Avatar Shark 250 Mobile Hard Drive, the HP SureStore CD Writer Plus 7200e, the Imation SuperDisk Parallel Port Drive, the Iomega ZipPlus, and the SyQuest EZFlyer 230 MB), hard disk complements (the Iomega Jaz 2GB, the Summatec MobileDrive, and the SyQuest SparQ 1.0 GB and SyJet 1.5 GB), and archive drives (the Iomega DittoMax and the Seagate TapeStor Travan 8GB).

All of the products tested use some form of removable media except the Summatec MobileDrive, which uses standard 2.5-inch hard disks that pop in and out of a special bay. And except for the HP SureStore CD Writer Plus 7200, which reads and writes to optical CDs, all of the reviewed drives use magnetic media. We also tested the magneto-optical (MO) drives and EIDE hard disks discussed in the sidebars "MO Drives: Solid Technology That Costs Too Much" and "A Second Hard Disk: Fast and Economical."

The EIDE-based SyQuest SparQ and Summatec MobileDrive came the closest to hard disk performance, followed by the SCSI-

based Iomega Jaz 2GB and SyQuest SyJet. The parallel-port versions of the SyJet and SparQ were limited by their slow interface but still outperformed all of the floppy-disk-class parallel-port drives except the Avatar Shark 250. Indeed, the Shark 250's performance on our benchmark tests was no worse with a parallel-port interface than with a PC Card. Surprisingly, the HP SureStore CD Writer Plus 7200e's optical drive mechanism outperformed two magnetic drives: the parallel-port Imation SuperDisk and Iomega ZipPlus.

Seagate's TapeStor Travan 8GB was the faster of the two archive drives, but Iomega's DittoMax showed versatility with a 125MB partition that can be treated as a mappable drive. It performed on a par with slower floppy-disk-class drives like the parallel-port version of the Iomega ZipPlus.



Backup and Restore

The backup and restore processes that we use in our Labs test how well each drive performs with the overhead of multiple files and complex directory structures. The Backup test exercises primarily the

write operations, while the Restore test executes read operations. Summatec's MobileDrive came out on top for backup, at 42 seconds, and second-best for restore, at 38 seconds. The SyQuest SparQ EIDE also boasted near-hard-disk performance: 52 seconds for backup and 40 seconds for restore. A faster hard disk like the IBM Deskstar 8—tested for comparison—backed up and restored in 26 and 27 seconds, respectively.

All of the hard-disk-class removable drives with SCSI and EIDE interfaces posted outstanding times on both tasks, except for the Iomega Jaz 2GB, which restored at a blazing 35 seconds yet took a full 3:38 for backup. In subsequent tests, the Jaz 2GB continued to sustain a high read throughput but showed poor efficiency in handling the write-verify process, especially when handling multiple small files. Among the floppy-disk-class drives, the SCSI-based SyQuest EZFlyer stood out as the best, with 1:39 on backup and

	Interface	Backup		Restore		Large-File Copy		Multifile Copy	
		Minutes	Seconds	Minutes	Seconds	Write (minutes seconds)	Read (minutes seconds)	Write (minutes seconds)	Read (minutes seconds)
Avatar Shark 250	PC Card	1:41		1:31		1:27	1:24	1:45	1:35
Avatar Shark 250	Parallel	2:30		2:11		2:27	2:05	2:32	2:14
HP SureStore CD-Writer Plus	Parallel	5:45		2:46		5:46	3:00	6:33	2:42
Imation SuperDisk*	Parallel	11:48		5:45		8:03	5:35	11:09	5:53
Iomega DittoMax	Parallel	11:48		7:24		8:27	8:31	8:38	8:35
Iomega Jaz 2GB	SCSI	3:38		0:35		0:58	0:27	2:05	0:35
Iomega ZipPlus	SCSI	2:17		1:20		2:14	1:21	2:22	1:23
Iomega ZipPlus	Parallel	8:28		9:26		8:53	9:36	8:39	9:37
Seagate TapeStor Travan 8GB	SCSI	10:38		5:33		10:51	6:21	N/A	N/A
Summatec MobileDrive	EIDE	0:42		0:38		0:25	0:25	0:37	0:38
SyQuest EZFlyer 230 MB	SCSI	1:39		0:55		1:15	0:53	1:40	0:54
SyQuest SparQ 1.0 GB	EIDE	0:52		0:40		0:38	0:35	0:54	0:41
SyQuest SparQ 1.0 GB	Parallel	3:33		2:00		3:03	1:56	3:41	2:01
SyQuest SyJet 1.5 GB	SCSI	1:34		0:44		1:21	0:45	1:35	0:48
SyQuest SyJet 1.5 GB	Parallel	3:15		2:01		2:20	1:59	2:19	2:06
		◀ BETTER		◀ BETTER		◀ BETTER		◀ BETTER	

N/A—Not applicable. The drive is not configured for this test. * The times shown are with the disk-spooling feature disabled.

0:55 on restore; Iomega's ZipPlus SCSI and Avatar's PC Card-based Shark 250 lagged behind slightly.

The parallel-port drives, limited by their interface, were unable to perform backups in less than 3 minutes or restores in less than 2 minutes. The most intriguing of these drives—the Imation SuperDisk—backed up 82MB in 1:08 when assisted by its bundled accelerator software, which spools the write operations to enhance perceived performance. But when this feature was disabled, the real performance revealed itself with a 12:05 backup. Subsequent tests showed that the advantage of the accelerator software is evident only in writing multiple small files to the removable drive or in performing random file access. The effect is negligible or even negative when retrieving data from the removable disk or transferring large files.

The two archive drives were the slowest of the bunch. Seagate's SCSI-based TapeStor Travan 8GB proved slightly faster than Iomega's parallel-port DittoMax, however.

Large-File Copy

The Large-File Copy tests gauge each drive's proficiency in sustained data throughput while copying a large TIF file. As with other tests, data-transfer time was measured in both directions: write (from the hard disk to the removable) and read (from the removable to the hard disk). The performance on these tests would be of interest to multimedia or graphics workstation users who often need to load, render, and save large files. Also noteworthy is the read/write ratio, which is wider in some drives than others.

The Summatec drive performed the best in both read and write functions, at 25 seconds for both, putting it in the class of fast standard EIDE hard disks like the IBM Deskstar 8 (which completed the read in 22 seconds and the write in 21 seconds). SyQuest's SparQ EIDE was not far behind, with a balanced read and write performance of 35 and 38 seconds, respectively. The Iomega Jaz 2GB was lightning-fast in read (27 seconds), but the write operation took about twice as long because of the hardware write-verify operation that is turned on by default.

Floppy-disk-class drives were led by the SCSI-based SyQuest EZFlyer, which outperformed the SCSI-based Iomega ZipPlus by

79 percent in write and 53 percent in read. The parallel-port floppy-disk-class drives varied widely in performance: Avatar's Shark 250 led the field at 2:05 in read and 2:27 in write, while Iomega's ZipPlus lagged far behind the others, including even the DittoMax tape drive. Imation's SuperDisk was in last place because the accelerator applet actually slowed it down on the Large-File Copy tests.

Multifile Copy

The Multifile Copy tests expose the latency associated with transferring multiple small files and stress the drive with handling inefficiently filled clusters. Comparing the results with the Large-File Copy tests reveals the severity of the inherent latency in each file transfer, while the read/write ratio is a further indicator of the drive's efficiency in handling multiple small files.

Summatec's MobileDrive and SyQuest's SparQ were again among the fastest, yet they required over 40 percent more time in writing 82MB worth of small files than in writing one large file of the same size. The Iomega Jaz 2GB was even less efficient, taking more than twice as long to write multiple small files than a single large file. The Jaz 2GB's write-verify function, while useful for maintaining data integrity, contributed to the inefficiency. With the feature enabled, an extra disk revolution is interleaved between write and verify; thus writing many small files introduces many wasted spins, whereas in a large file only one rotation is inserted between write and verify.

When testing the parallel-port drives, we found that the read and write operations did not vary much between copying small files and one large file. This is because the slow parallel-port interface masked any performance degradation due to wasted disk revolutions.

ZD Business Winstone 98

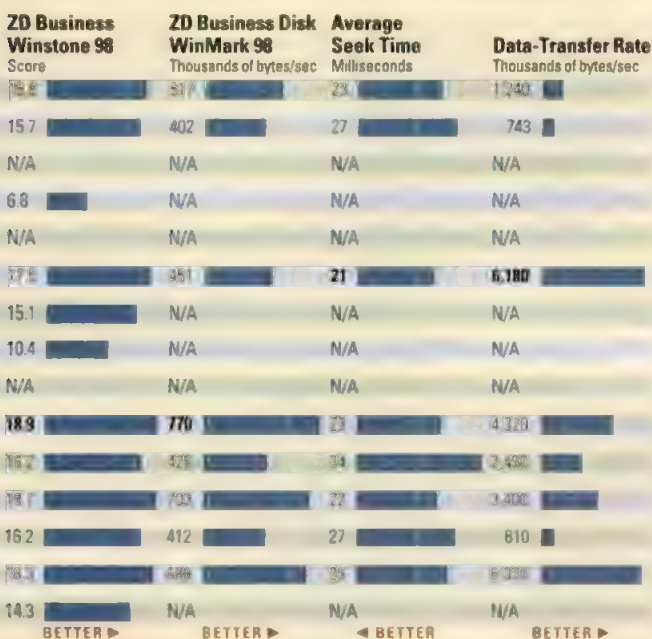
The ZD Business Winstone 98 score is a good indicator of how well business applications can be run directly from the removable drive—a key attribute particularly in hard disk complements. The test rewards drives with faster random seek times.

Three drives displayed near-hard-disk performance levels on this test program, with Winstone scores above 18: the EIDE-based Summatec MobileDrive, the EIDE-based SyQuest SparQ, and the SCSI-based SyQuest SyJet. Iomega's Jaz 2GB fell shy at 17.5.

Among the floppy-disk-class drives, the SCSI version of the Iomega ZipPlus and SyQuest EZFlyer, along with the Avatar Shark 250 in both PC Card and parallel-port versions, demonstrated acceptable speed in running business applications. The parallel-port ZipPlus reduced the Pentium II/266 test-bed's performance to that of a Pentium/133, and the Imation SuperDisk's score of 6.8 proved inadequate for running business applications off the removable drive. Using the accelerator software, however, the Imation drive produced a user experience equivalent to a Business Winstone score of 18.3.

How We Tested

We installed all of the drives onto a Pentium II/266-based Micron Millennia running Windows 95 (OSR 2). The test-bed system was equipped with 32MB of RAM, 512K of L2 cache, a Maxtor 84320 D4 4GB EIDE hard disk, and a Diamond Stealth 2000 3D graphics card with 4MB of graphics memory. We set the graphics card to 1,024-by-768 resolution and 24-bit color. The SCSI drives were tested using an Adaptec AHA-2940AU Ultra-Wide PCI SCSI adapter, and we tested the parallel-port drives on the test-bed after installing an EPP driver, which enabled the high-speed parallel-port mode. We tested all drives using default software and did not change the firmware settings during installation.



BENCHMARK TESTS

Our **Backup and Restore** tests measure the time elapsed in backing up 80MB of data in nested folders (355 files in 60 folders) from the primary hard disk to the removable drive. We then measure the time elapsed in restoring the same data from the removable drive back to the hard disk. To execute these tests (as well as the two subsequent pairs of tests), we use Ctrl-C (to copy) and Ctrl-V (to paste) in Windows 95 Explorer. The elapsed time is measured from the moment Ctrl-V is pressed to the time when the mouse cursor returns to arrow form from hourglass form. In the case of the two tape-backup drives (the Iomega DittoMax and the Seagate TapeStor Travan 8GB), we performed the test using the bundled backup software.

The **Large-File Copy** tests measure the time required to transfer an 82MB TIF file from the hard disk to the removable drive and the time required to copy the file back from the removable drive to the hard disk.

The **Multifile Copy** tests measure the time required to transfer 82MB of data in 333 files from the hard disk to the removable drive and the time required to copy the data back from the re-

movable drive to the hard disk.

We use the application-based **ZD Business Winstone 98** benchmark test program to measure the test-bed system's overall performance in running business applications from the removable drive. The applications are grouped into four categories (Database/Spreadsheet, Word Processing, Publishing, and Browsers), and the test results are profiled to produce the overall Winstone score.

We also ran disk-specific benchmark tests from **ZD WinBench 98**. The first group of these, **ZD Business Disk WinMark 98**, uses many different files, directories, and file operations in blends that play back a recording of the disk usage by those applications profiled in Business Winstone 98. The score is computed using a weighted harmonic mean of the data throughput (in thousands of bytes per second) while running these applications. The **Average Seek Time** is the time (in milliseconds) required for the drive head to move a third of the radial distance over the data-storing part of the drive's media. The **Data-Transfer Rate** test measures the drive's best possible sustained sequential data throughput, in thousands of bytes per second.

Imation SuperDisk Parallel Port Drive. List price: \$149; \$99 with rebate. Imation Corp., Oakdale, MN; 888-466-3456, 612-704-4000; www.imation.com. Choose 503 at www.pcmag.com/infolink.

Iomega DittoMax, ZipPlus, Jaz 2GB



Whether you want a tape drive, a low-capacity removable drive, or a high-capacity drive, Iomega Corp. offers one. For this roundup, we looked at each type: the

Iomega DittoMax tape drive (\$199 list), the 100MB Iomega ZipPlus (\$199 list), and the external Iomega Jaz 2GB (\$649 list). The DittoMax is a clever take on tape storage that lets you use different-size cartridges, depending on your capacity needs now and in the future. The ZipPlus is an excellent choice if you need to share data with some of the 11 million other Zip-equipped users. And the Jaz has a following large enough to make it a contender as well.

Iomega has maintained the same cartridge design and data format for the ZipPlus, ensuring that the new model is fully compatible with the millions of preexisting Zip drives already shipped—some of which were built-in options on

PCs from major vendors. The Zip is now the leading contender among floppy disk-replacement wanna-bes. All this, plus a \$13 price per disk (13 cents per megabyte), makes the Zip the format of choice for file exchange of up to 100MB per disk. If you need to send a large file to someone, chances are there is a Zip available to read it.

The external ZipPlus offers several improvements over the original. High on the list is an auto-detect feature that lets you plug into either a parallel port or Iomega's own SCSI card, using the parallel-port-style connector on the cable. You

limited backup-and-restore program, a utility to set the disk as *fixed*, and bonus applications (with Adobe PhotoDeluxe chief among them). You'll also find a Guest utility on a floppy disk, which lets you attach your Zip Drive to a different PC via the parallel port without permanently installing it.

Iomega asserts that the ZipPlus is faster than the standard Zip Drive, though it's still not fast compared with newer entries from Iomega and SyQuest. Only the Imation SuperDisk Parallel Port Drive (with its spooling feature disabled) was slower than the ZipPlus among disk-

based drives, whereas the SCSI ZipPlus was the slowest SCSI disk drive we tested. Look to ZipPlus if 100MB chunks are all you need and if you have to share data with other users; it's the closest thing to a de facto standard for file exchange. If it's just for personal use, however, you can get better speed and more capacity from the Avatar Shark 250 or the SyQuest SparQ at a similar price.

On the other end of the spectrum is the Jaz 2GB, which offers capacity and performance suitable for complementing (or even replacing) your hard disk. The drive can read and write 1GB first-generation Jaz disks and its own 2GB disks, which cost about \$150 per disk (a reason-



Iomega's ZipPlus, DittoMax, and Jaz 2GB drives run the gamut from floppy disk replacement to high-capacity hard disk complement.

can also use a standard SCSI card if you buy the appropriate port adapters.

For parallel-port or SCSI version, installation is simple, and there's an ample software bundle that includes a

Show 'em a thing or two.

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FUTURE DRIVES Are They Worth Waiting For?

The trip from the research lab to the computer superstore is a long and treacherous one, and products based on budding technologies almost always miss their projected release dates. Six interesting storage products, not ready in time for this roundup, are promised by year's end. (For comparing speed, note that a Zip Drive has a claimed throughput of 1.1 MBps for reads and writes, and a typical EIDE hard disk can sustain 7.0 MBps.)

HfD

Sony Electronics, 800-352-7669.

www.sony.com/storagebysony.

STATS: 200MB formatted capacity on proprietary 3.5-inch disks; can read and write standard 3.5-inch, 1.44MB floppy disks; cost per megabyte not available; write speed, 1.2 MBps; read speed, 3.6 MBps.



Sony's 200MB HfD drive could become the standard if adopted later this year.

TECHNOLOGY: Magnetic.

AVAILABILITY: Q3 1998.

IMPACT: This could be widely adopted as a replacement for the standard 1.44MB floppy disk (leapfrogging the LS-120 and the Zip), as it is large enough for near-line storage and fast enough for multimedia.

THE ODDS: On a rainy day, bet on the gray horse—and never bet against Sony.

ACE IN THE HOLE: Sony made its 3.5-inch floppy disk the standard last time around, and it could duplicate the feat.

ORB

Castlewood Systems Inc., 510-224-9900.

www.castlewoodsystems.com.

STATS: 2.16GB formatted capacity on proprietary 3.5-inch disks; estimated cost per megabyte, 1.4 cents; estimated throughput, 12.2 MBps.

TECHNOLOGY: Magnetic; uses magneto-resistive (MR) heads for enhanced capacity and speed.

AVAILABILITY: Q1 1998.

IMPACT: Low cost for the drive (\$200) and low media costs (\$30 per cartridge) give the product a strong price advantage. But it is competing in a tough market segment with established products from Iomega (Jaz) and SyQuest (SyJet).

THE ODDS: Even money.

ACE IN THE HOLE: Company founder Syed Iftikar was the founder of SyQuest and a cofounder of

hard disk giant Seagate. (That is, he's done this before.)

Quest

SyQuest, 800-245-2278.

www.syquest.com.

STATS: 4.7GB formatted capacity on proprietary 5.25-inch disks; estimated cost per megabyte, 4 cents; estimated write speed, 5.5 MBps, estimated read speed, 10 MBps.

TECHNOLOGY: Magnetic.

AVAILABILITY: Q1 1998.

IMPACT: This \$599 drive ups the capacity ante substantially for removable drives with near-hard disk performance and could woo buyers who were considering adding a fixed disk.

THE ODDS: In a crowded, muddy field, pick it to show.

ACE IN THE HOLE: It's out of the labs and should be available as you read this.

DVD-RAM

Hitachi, Panasonic, Toshiba, others.

STATS: 2.6GB formatted capacity per side on 120-mm optical disks (single- or double-sided media available); can read DVD-ROM disks and all CD formats; estimated cost per megabyte, less than 1 cent; write speed, 1.3 MBps; read speed: DVD-RAM media, 1.3 MBps; DVD-ROM media, 1.5 MBps; CD media, 2.4 MBps.

TECHNOLOGY: Optical phase-change.

AVAILABILITY: End of Q1 1998 (though shipment dates have slipped repeatedly already).

IMPACT: The huge capacity and read-compatibility with DVD-ROM and CD media could make DVD-RAM a natural choice for business and home PCs. It can read but can't write CD formats, however, and competition looms from DVD+RW.

THE ODDS: Hedge your bet with some money on DVD+RW.

ACE IN THE HOLE: DVD-RAM could be the convergence medium, used for everything from PC storage to replacement for VHS tape in home video recorders.



DVD-RAM may become the next high-density recordable CD standard.

DVD+RW

HP, Philips, Sony, others.

STATS: 3.6GB formatted capacity per side on 120-mm optical disks (single- or double-sided media available); can read DVD-ROM disks and all CD formats; estimated cost per megabyte, less than 1 cent; write speed, at least 1.2 MBps; read speed, at least 1.2 MBps.

TECHNOLOGY: Optical phase-change.

AVAILABILITY: Q3 1998.

IMPACT: As with DVD-RAM, capacity, backward compatibility, and low cost per megabyte make this an intriguing format. But DVD-RAM has a head start in the market. We may be witnessing another Beta-versus-VHS showdown.

THE ODDS: Hedge your bet with some money on DVD-RAM (and remember what we said about Sony).

ACE IN THE HOLE: Philips and Sony claim that future DVD+RW drives will be able to read and write CD formats for existing CD-ROM and audio CD players, which might convince some buyers to wait.

Near-field recording (working title)

TeraStore Corp., 408-324-2110.

www.terastore.com.

STATS: 20GB formatted capacity on proprietary 5.25-inch disks; estimated cost per megabyte, 0.5 cents; claimed throughput, "near hard disk."

TECHNOLOGY: Near-field technology, a proprietary magneto-optical technology that uses a flying head (like a hard disk) with a solid immersion optical lens (developed at Stanford University) to record high areal densities on the magnetic surface of a plastic substrate.

AVAILABILITY: Q3 1998.

IMPACT: The staggering capacity—two to five times current hard disks, at the same price—and good claimed performance make near-field recorders ideal for network storage needs to replace tape and MO technologies for online and near-line archiving, digital image and video storage, and more. Also a potential adjunct to (or replacement for) traditional hard disks in desktop PCs, though the technology has not yet been proven commercially.

THE ODDS: This dark horse could go on to win the Triple Crown.

ACE IN THE HOLE: TeraStore intends to license the technology to other drive manufacturers to fuel quick and widespread acceptance. The company already has strategic agreements with major companies including Hitachi, Imation, Maxell, Mitsumi, Quantum, and Seagate.

—Alfred Poor

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able 8 cents per megabyte).

The Jaz is SCSI-only, but you can get an optional converter for hooking it up to a parallel port. Unlike the ZipPlus, it uses an ultra SCSI connector. Minimal installation consists of plugging in the cable and power cord and booting up. You get essentially the same utilities as with the ZipPlus—but no application programs. You can also use a full-scale backup program and a disaster-recovery utility to let you restore to a new hard disk without reinstalling Microsoft Windows.

In our Labs, the Jaz essentially tied with the Summatec MobileDrive on read tests, and it did well when we tried writing large files to the drive. But it performed surprisingly poorly for a SCSI drive on tests that wrote lots of small files to the drive; typical backup chores involving many subdirectories are not its forte. The Jaz 2GB does offer a third more capacity than the SyQuest SyJet 1.5 GB, but its performance is similar (or in some cases worse), and it costs more than twice as much. Buyers might be better served by

the SyJet or by the still-available internal version of the Jaz 1GB (\$299.99 list).

For those who need a tape drive, the DittoMax (\$199 list), with 3.5GB to 10GB uncompressed capacity, offers plenty of room for backups. It's a typical minicartridge drive in most ways, except that it uses a proprietary format and sets aside an uncompressed 125MB on each tape for a Flash!File section, which looks like a disk to Windows 95. The tapes come in three capacities, ranging from \$20 to \$30 per tape.

MO DRIVES Solid Technology That Costs Too Much

Magnetic cartridge drives such as the Jaz and SyJet may be all the rage now, but when magneto-optical (MO) technology first hit its stride in the early 1980s, it showed promise as the removable storage medium of choice for the PC world. Indeed, MO drives still have a long list of advantages, counterbalanced by just one drawback: cost.

We tested three representative MO drives—one at each of the current capacity points—to see where they fit into the removable-storage market.

MO drives use magnetic media with a difference: a high Curie point, which means that for magnetic particles to change polarity in order to store digital bits, the drive must raise the media temperature to about 300 degrees Celsius. To write (or erase) data, an MO drive uses a tightly focused laser beam to heat a tiny spot on the disk. Reading, however, requires only conventional optical technology.

This unique combination affords MO several advantages over other types of storage.

Capacity. MO allows reasonably high-areal densities, hence good capacity. The current 3.5-inch cartridges are rated at 640MB, while 5.25-inch media can store 2.6GB or even 4.6GB per cartridge. This year, 5.2GB drives

should become available. (A note on capacity: MO figures are optimistic. A 640MB cartridge has about 599MB of useful storage on a single side after formatting. The 2.6GB and 4.6GB cartridges are double-sided: You have to eject and flip the media to access the full capacity, which after formatting equals roughly 1.1GB or 2.1GB per side.)

Performance. Because the drives use magnetic technology to read data,



For the fastest MO write-speed performance, look to the Maxoptix T5-2600.

transfer rates for MO drives rival those of a standard hard disk. Writing takes a little longer than on a hard disk because of the laser technology, but performance is fine for primary or near-line storage.

Durability. Because the bits are written and erased optically, normal magnetic fields don't affect your data. Also, the disks are permanently fixed in

rugged cartridge shells that manufacturers have made to demanding shock-tolerance standards. MO vendors rate the useful life of the data stored on the media in excess of 30 years.

Compatibility. Most MO vendors have agreed to keep newer drives backward-compatible within at least two previous generations of MO capacity points. For example, a 3.5-inch 640MB MO drive can accept the older 530MB, 230MB, and 128MB cartridges. Also, most capacity levels follow ISO file-format standards, so cartridges can be exchanged between drives of different manufacturers.

These strengths have given MO a foothold in several key markets such as medical imaging, digital video editing and storage, near-line database storage, and more.

SO WHAT'S NOT TO LIKE?

Why are you exchanging a Zip disk with the guy in marketing, and not an MO disk? Price. While storage costs are very competitive with other removable storage media (around 4 to 8 cents per megabyte, depending on the capacity), drive prices are prohibitive. A 640MB drive costs about \$600; a 2.6GB unit can cost \$1,800. By comparison, a SparQ 1.0 GB from SyQuest costs \$200. For personal desktop use, the choice is easy.

	Backup Minutes:seconds	Restore Minutes:seconds	Large-File Copy Write (minutes:seconds)	Read (minutes:seconds)	ZD Business Disk WinMark Thousands of bytes/sec	Data-Transfer Rate Thousands of bytes/sec
Bold type denotes first place. Maxoptix T5-2600	1:40	0:42	1:17	0:32	280	2,900
Pinnacle Micro Apex 4.6 GB	2:12	0:35	1:31	0:29	368	3,140
Verbatim Mitsubishi MCA640	4:07	0:55	3:24	0:51	289	1,790
	◀ BETTER	◀ BETTER	◀ BETTER	◀ BETTER	BETTER ▶	BETTER ▶

Removable Storage

Installation of the DittoMax is standard for an internal drive. Mount it in a bay and connect the power and data cable, either to a floppy disk controller or to the 4-Mbps accelerator card offered. The package includes a full-function backup-and-restore program, along with a disaster-recovery utility.

As with other tape drives, performance is less than stellar but better than you might expect, thanks to the accelerator card. We timed it at 11 minutes 48 seconds for the 80MB backup and 7 min-

utes 24 seconds for the restore. The Flash!File section can be useful for archiving files that you may want to get at without having to restore them first to your hard disk. If you consider its speed acceptable, DittoMax will do the job, whereas Flash!File and the three cartridge choices add welcome flexibility.

—M. David Stone

Iomega DittoMax. List price: \$199 list. **Iomega ZipPlus.** List price: \$199. **Iomega Jaz 2GB.** List price: \$649. Iomega Corp., Roy, Utah; 800-697-8833, 801-778-1000; www.iomega.com. Choose 504 at www.pcmag.com/infolink.

Seagate TapeStor Travan 8GB

Prices for hard disks and removable disks keep falling, but tape is cheaper still, which makes it the medium of choice for full-scale backups. Seagate Technology's TR-



Big capacity and low storage costs are the hallmarks of the Seagate TapeStor Travan.

4 drive, the Seagate TapeStor Travan 8GB (tested configuration, \$390 street; EIDE version, \$330), offers the additional benefit of either a SCSI or an EIDE interface to help speed backups—though the unit is still much slower than disk-based drives.

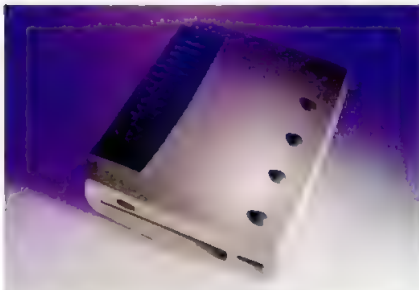
The price for a tape cartridge, at 4GB native capacity (8GB with compression) averages at \$35, which works out to less than 1 cent per megabyte. This much capacity at this price should appeal to anyone who needs to store a large amount of archived data. Installation is typical for an internal SCSI drive: Mount it in a bay and plug in the power and data cables. The process is unusual in one respect, however: You have to install the software before the hardware, or the software won't work.

This software is a TapeStor-specific version of Seagate's Backup Exec, a full-function program that earned an Editors' Choice in our story on personal backup utilities ("Back Up Your Work," March 24, 1998). Among its most important features is disaster recovery, so you can restore to a new hard disk should your disk die—without having to install Windows 95 first.

Alas, even with the SCSI interface, tape technology just can't keep pace with magnetic-disk technology. On our tests, the drive took 10 minutes 38 seconds to finish our 80MB Backup test (including a separate verify pass), compared with less than 2 minutes for disk media. It took 5

WORKING WITH THE DRIVES

Since MO drives universally use the SCSI interface and operate exactly like hard disks, all conventional disk utilities work in a familiar way. Installing each of the three drives is easy. Once



The proprietary-format Apex 4.6GB delivers the best MO bang for your buck.

your SCSI host adapter is installed, you need only set an ID number and the termination on the drive. Then plug the drive in; Windows will recognize and use it without any further software or driver installation.

The 3.5-inch **Verbatim Mitsubishi MCA640** (external, \$430 street; internal, \$390) reads and writes 640MB, 530MB, and 230MB cartridges and can read the 128MB format. This drive was slower than the larger-capacity MO drives we tested for write operations and predictably lagged the magnetic-based drives as well. But for read operations, the drive held its own with the fastest we tested of any technology. (Verbatim Corp., a subsidiary of Mitsubishi Chemical America Co., Charlotte, NC; 800-421-4188; www.verbatimcorp.com. Choose 510 at www.pcmag.com/infolink.)

The 2.6GB **Maxoptix T5-2600** (external, \$1,984 list; internal, \$1,859) was the

fastest MO drive in the group: Its write times on our tests were generally just a few ticks behind the SCSI magnetic-based drives, and its read times were generally ahead of the pack. If you are committed to MO and want to move up to the current generation, this drive is worth a look. (Maxoptix Corp., Fremont, CA; 800-848-3092; www.maxoptix.com. Choose 508 at www.pcmag.com/infolink.)

To achieve a 4.6GB capacity while other MO makers were at 1.3GB, Pinnacle Micro broke from the industry and created a proprietary format for its **Pinnacle Micro Apex 4.6GB** drive (external, \$1,495 list; internal, \$1,395). So while the Apex reads and writes 2.6GB cartridges, it can't read older formats, and its 4.6GB cartridges can be read only by another Apex drive. The Apex was generally a bit slower than the Maxoptix on write operations but a tick faster for reads. If you don't mind a proprietary solution, the Apex offers the most MO bang for your buck right now. (Pinnacle Micro Inc., Irvine, CA; 800-553-7070; www.pinnaclemicro.com. Choose 509 at www.pcmag.com/infolink.)—Winn L. Rosch



The 3.5-inch Mitsubishi MCA640 offers less capacity at a lower price.

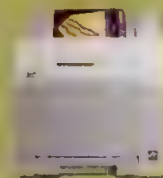


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SECOND HARD DISK Fast and Economical

For many users, a removable drive like those reviewed in the main story is an essential tool. But just as many users don't need to transport or share large files; they just need more room. For them, installing a second hard disk might be the better solution. And as hard disk capacities have grown, prices have dropped: You can pay as little as 3 cents per megabyte, compared with 8 cents per megabyte for a 2GB Iomega Jaz cartridge. Makers have invested a lot of effort into making the drives easy for end users to install and configure. Best of all, no removable drive can quite match the overall performance of a fixed hard disk.

IN THIS ROUNDUP

We tested internal hard disk offerings from the five leading hard disk makers: IBM, Maxtor, Quantum, Seagate, and Western Digital. Since the vast majority of PC systems have EIDE primary drives (not SCSI), we asked for each maker's highest-capacity EIDE kit, which had to include end user instructions and any necessary cabling and hardware. (Note that all the vendors had higher-capacity drives also, but packaged for PC manufacturers and system integrators, not you and me.)

We tested the drives on a Micron Millennia 233-MHz Pentium desktop PC with a primary Western Digital Caviar EIDE drive installed. After installation, we partitioned each drive as one logical drive, formatted, and ran our standard benchmark tests: ZD Business Winstone 98, Business Winbench Disk Winmark 98, Average Seek Time, and Data-Transfer Rate. A host of factors affect a hard disk's performance: the rate at which the platters spin (cited in rpm), its areal density (how tightly packed the data bits are), and the size of the cache.

INSTALLATION AND SETUP

Most desktop PC cases have ample space for an extra drive and already include the cables needed to install one. Typically, the EIDE data cable

for the primary drive has a second connector that plugs into the back of the second drive, which, like the additional power lead you also plug into the drive, is keyed so you can't insert it the wrong way.

Before you install a new drive—which you should do with the computer powered down *and* unplugged—



If you just need more storage and don't need to take it with you, consider these standard hard disks from IBM, Maxtor, Quantum, Seagate, and Western Digital.

you should check that both the original drive and the new secondary drive have jumpers installed correctly to enable the computer to differentiate between the master and the slave drives. Most PC motherboards have two EIDE connectors, each of which can support two EIDE devices. One device is designated the master of the given channel, and the other should be set to be the slave. Unless the settings are accurate, the PC's BIOS, and therefore the operating system, may not be able to see the second drive. Most drives have clear markings to indicate where to place the tiny circuit jumpers for master and slave settings.

Depending on the version of Windows and your computer's BIOS capabilities, your computer may not be able

to format and use the full capacity of the larger drives without additional drivers or software. All the tested drives included the necessary drivers and disk management utilities to allow full usage of their storage potentials.

IBM DESKSTAR 8

The IBM Deskstar 8 (\$360 street), a 3.5-inch drive, has a compelling balance between price and performance. The ATA-3 8.4GB drive has a spin rate of 5,400 rpm and a 512K buffer. Cost per megabyte is 4.3 cents, and the drive had consistently high scores in performance testing. The Deskstar 8 is targeted at retail and corporate users looking for top performance from an EIDE hard disk.

Installation was uneventful, and the DiskManager software made configuration and drive setup simple. Users of older machines, take note: IBM guarantees that the Deskstar 8 will work and be compatible for the full 8.4GB capacity with 486 or better PCs and 400MB primary IDE drives or better; if it doesn't work you can get your money back.

In testing, the Deskstar was at or near the top on our benchmark tests. It turned in the best Disk WinMark score and had one of the best data-transfer rates. For performance at a good price, you needn't look further than the IBM Deskstar 8. (IBM Personal Systems Group, Research Triangle Park, NC; 800-772-2227; www.us.pc.ibm.com. Choose 511 at www.pcmag.com/infolink.)

MAXTOR DIAMOND MAX 2160

If you're willing to trade a little performance to save a few dollars, the 3.5-inch Maxtor DiamondMax 2160 (\$330 street) is a good buy at 3.8 cents per megabyte. The 5,200-rpm Ultra DMA ATA-4 drive was not the fastest on our tests, but it should prove fast enough as either a primary or secondary hard disk.

The MaxBlast installation software that comes with the Diamond-

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BECAUSE IT'S



REALLY

Max 2160 includes a utility that led us through installation and configuration with no problems. The DiamondMax turned in an average score on our Disk WinMark tests, though its measured data-transfer rate lagged the other drives. Still, the difference in time to launch applications and load large files would probably not be noticeable without a stopwatch. (Maxtor Corp., Milpitas, CA; 800-262-9867, 408-432-1700; www.maxtor.com. Choose 512 at www.pcmag.com/infolink.)

QUANTUM BIGFOOT TX 12GB

The Quantum Bigfoot TX 12GB (\$400 street), the sole 5.25-inch drive in this group, is the value leader. With a price of just 4 cents per megabyte, it provides the greatest total capacity and the lowest cost per megabyte of the tested drives. The Bigfoot was not an outstanding performer on benchmark tests because of its relatively slow 4,000-rpm spin rate and longer seek time. But for loads of storage (assuming you have a free 5.25-inch bay), the Quantum drive is a great deal.

The bundle includes Disk Manager 9.0 for Windows, the popular drive configuration and management utility, and Symantec's Norton Smart Drive for Windows. The Quantum drive had solid midrange scores on all our tests, making up for the relatively low rpm rate by having more data per sector on its larger platters. Many smaller desktop PCs don't have 5.25-inch drive bays, and other users may have used (or plan to use) their available slots with CD-R or DVD-ROM drives. But if you have a system with room for the Quantum Bigfoot TX 12GB, it should provide ample storage for years to come. (Quantum Corp., Milpitas, CA;

800-624-5545, 408-894-4000; www.quantum.com. Choose 513 at www.pcmag.com/infolink.)

SEAGATE MEDALIST PRO 9140

The Seagate's Medalist Pro 9140 (\$495 street), a 9.1GB drive boasting a 7,200-rpm spin rate, is a fast drive for performance-oriented users. At 5.4 cents per megabyte, the drive isn't the price leader, but its capacity and elegant design earn it a hearty recommendation.

impressive design features to aid installation and protect the drive, makes the Seagate Medalist Pro 9140 a good bet for demanding applications. (Seagate Technology Inc., Scotts Valley, CA; 800-732-4283, 405-936-1210; www.seagate.com. Choose 505 at www.pcmag.com/infolink.)

WESTERN DIGITAL CAVIAR AC36440

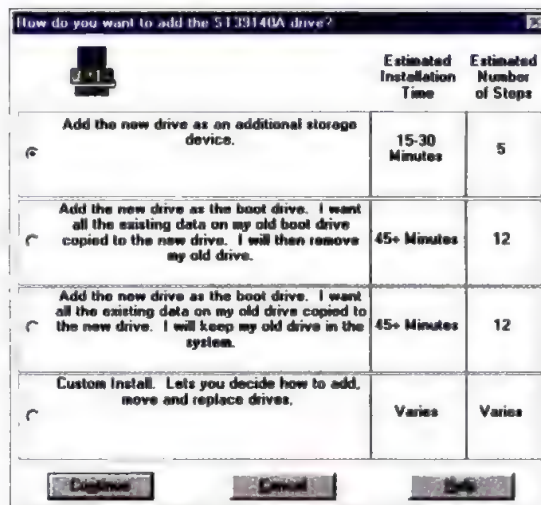
The Western Digital Caviar AC36440 (\$330 street), an Ultra

DMA unit, is the lowest-priced drive tested but also has the smallest capacity of the internal drives. At 5 cents per megabyte, its price falls in the middle of the pack, but the Caviar turned in the best throughput of any of the tested drives.

The 6.4GB Caviar installed easily after an initial glitch. The documentation tells you to boot from the included EZ Drive disk, but it doesn't work. Western Digital's automated technical support line provided the answer: Boot

first from a master disk, then type EZ to start the drive configuration and management program.

The Caviar was behind the pack on our Disk WinMark tests but managed to best all the others on the Data-Transfer Rate test, which bodes well for large-file reads and writes. A high-quality drive that's widely available, the Caviar is a reasonable choice for mainstream systems. (Western Digital Corp., Irvine, CA; 800-832-4778, 714-932-5000; www.wdc.com. Choose 514 at www.pcmag.com/infolink.)—BB



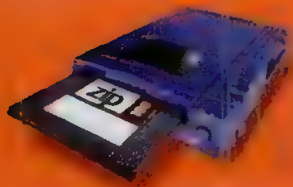
Seagate's excellent DiscWizard installation routine walks you through the process.

Seagate places a plate (called the "SeaShield") over the printed circuit board of the drive to protect it against electrostatic damage—and cleverly puts installation and configuration instructions there. DiscWizard installation software uses animated graphics that aid in drive installation, including identifying existing drives and telling you how to set jumpers depending on the way you install and use your original and new drives.

The Ultra DMA drive was consistently at or near the top on our benchmark tests. This performance, plus

	ZD Business Winstone 98 Score	ZD Business Disk WinMark 98 Thousands of bytes/sec	Average Seek Time Milliseconds	Data-Transfer Rate Thousands of bytes/sec
Bold type denotes first place. IBM Deskstar 8	19.7	1,140	16	7,220
Maxtor DiamondMax 2160	19.1	1,030	18	4,060
Quantum Bigfoot TX 12GB	19.4	989	19	5,740
Seagate Medalist Pro 9140	19.8	1,080	14	7,950
Western Digital Caviar AC36440	19.1	919	17	7,930
	BETTER ►	BETTER ►	◄ BETTER	BETTER ►

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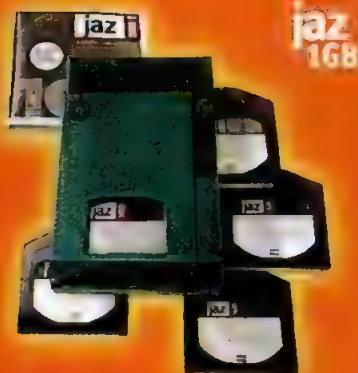
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† Assuming 2:1 compression ratio. Actual compression will vary with file and hardware configuration.

‡ Performance will vary when using 1GB cartridges.
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STEVE JORDAHL

IS Analyst and Developer

McDonnell Douglas

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minutes 33 seconds to restore the files, and timing could be longer if the drive had to spool far to the data.

But if you're looking to tape, you're looking for capacity and low storage costs in lieu of speed. In this regard, the TapeStor will do the job admirably, thanks to its excellent software.—**MDS Seagate TapeStor Travan 8GB.** Street price: Tested configuration, \$390; EIDE version, \$330. Seagate Technology Inc., Costa Mesa, CA; 800-626-6637, 714-641-1230; www.seagate.com. Choose 505 at www.pcmag.com/infolink.

Summatec MobileDrive

When it comes to speed and capacity, nothing matches a traditional hard disk—the kind without removable platters. But if you want it all—speed, capacity, and removability—consider the Summatec MobileDrive (tested configuration, \$340 street). This product gives a performance that is truly a match for hard disks, for the simple reason that it is one. If you want a high-speed, high-capacity removable-storage solution, the MobileDrive is an intriguing choice.

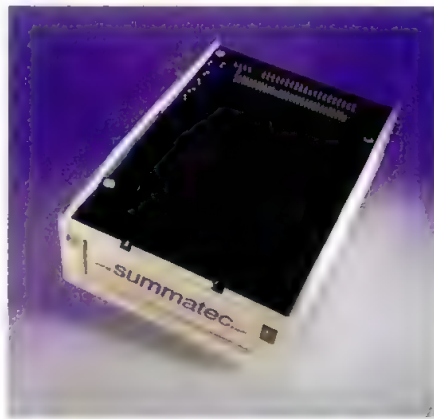
The heart of the MobileDrive is a standard 2.5-inch hard disk mechanism (the kind used in laptop PCs) mounted in a removable cartridge. The docking station for the cartridges (\$120) is mountable in a standard 5.25-inch drive bay of your PC; you can also opt for the external docking-station model (\$240) with either SCSI or PC Card connections. Capacity of the cartridges ranges from 2.1GB to 5GB (\$220 to \$560), and the company plans to offer higher-capacity cartridges as they become available.

The installation of the internal configuration we tested was fairly easy, and typical, for an EIDE drive. Just mount it in a bay, and connect the power and data cables. Then set your BIOS, preferably to auto-recognition, so you won't get an error message if you change or remove the drive. Finally, slide the drive into the slot and let the motorized mechanism lock it into place.

At that point, you simply use the unit like a hard disk. This is why it includes no bundled software. Not surprisingly, the internal version we tested was easily the best performer of all the removable drives in this roundup. With its speed and capacity, the MobileDrive is a contender if you

want to swap operating systems or if you wish to keep your virtual machine away from the kids' meddling on a home PC.

At around 24 cents per megabyte, the MobileDrive is pricey compared with more



The pricey Summatec Mobile Drive offers speed, capacity, and removability.

traditional removable-cartridge drives such as the Jaz (8 cents per megabyte) or the SparQ (3 cents). But it's also a no-compromise solution that delivers capacity and speed as well as removability.—**MDS Summatec MobileDrive.** Street price: Tested configuration, \$340. Summatec Computer Corp., Vista, CA; 800-971-7713, 760-726-7807; www.summatec.com. Choose 506 at www.pcmag.com/infolink.

SyQuest EZFlyer, SparQ, SyJet



SyQuest Technology's offerings range from a 230MB floppy disk drive replacement to a 1.5GB hard disk complement, and its 4.7GB Quest hard disk rival was in the works at test time (see the sidebar "Future Drives: Are They Worth Waiting For?"). We tested the SCSI version of the SyQuest EZFlyer 230 MB (\$150 street) and two configurations each of the SyQuest SparQ 1.0 GB (\$200 street) and SyQuest SyJet 1.5 GB (\$300 street). All were impressive performers, and the SparQ and SyJet drives stand out as unusually good values.

At the low end, the EZFlyer 230 is essentially a supersize floppy disk drive that uses a \$25 removable hard disk instead of a floppy disk. Compatible with the 135MB cartridges of its predecessor, the SyQuest EZ135 Drive, the EZFlyer is available in three models—internal EIDE, external SCSI, and external parallel-port. We tested the external SCSI version.

The installation is simple: Plug in the power and SCSI cables, turn your system on, and boot. Bundled software includes a backup utility and a utility for defining the drive as a fixed disk. Performance was much faster than that of other floppy disk drive wanna-bes such as the Iomega Zip-Plus. On our tests, the EZFlyer turned in the best performance for any drive with a capacity of under 1GB. Technology pushes ahead, however, and this past winner of our Editors' Choice has been leapfrogged by its sibling—the new SparQ—in terms of capacity, performance, and overall value.

The SparQ costs about \$50 more for the drive and \$8 more per disk, but with this unit you get better performance and four times the capacity of the EZFlyer. Given the lack of a large installed base or a notebook version for easy portability, the EZFlyer is best reserved for those who already have an investment in the EZ family of drives. Most people will be better off spending a few extra dollars for the SparQ.

SyQuest sees the SparQ (which we tested in both internal EIDE and external parallel-port versions) as its consumer drive. It's aimed at home and small-office users, for archiving, backup, gaming, and Internet downloads. The 1GB disks cost \$33 each in a three-pack, making storage costs an excellent 3 cents per megabyte.

Setting up the SparQ is standard fare. For the EIDE version, set the drive as master or slave, plug in the power and data cables, adjust your system BIOS settings, and boot. For the parallel-port version, just plug in the power and data cables, install the driver, and boot. In both cases you can opt to install utilities that are essentially identical to those for the EZFlyer 230.

Both SparQ models include a series of special applications, including Serif Draw-Plus and NovaStor Corp.'s backup program NovaDisk SE. One feature unique to the parallel-port version is the Visit utility. Simply bring the Visit floppy disk whenever you want to move your SparQ to another PC and you can use the drive without installing the complete Windows 95 driver.

The EIDE version of the SparQ did well on our benchmark tests, matching and often beating the Iomega Jaz 2GB and SyJet drives during backup, restore, and copy functions. As you would expect, performance is significantly slower over the parallel port. Still, the external SparQ

"How I fit 1 speeding downtown bus,
a crippled lunar lander, and
5 car-tossing tornados into a
4 INCH SQUARE."



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As the two-time Academy Award-winning sound effects specialist whose work includes films like *Speed*, *Apollo 13*, and *Twister*, Stephen Hunter Flick works with major movie studios creating some of film's most incredible effects. From compiling over 2,000 sound files to create a massive tornado to transporting or even cutting straight to digital picture, Stephen's work takes big space. With his Jaz drive and its sustained transfer rate of up to 6.62MB per second, he can back up 1 whole gigabyte in as little as 10 minutes. The Jaz drive not only gives him the flexibility to run applications and files straight from disk, it's also compatible with nearly all operating systems. So while Stephen's work is truly larger than life, it still fits neatly into his pocket.

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model was one of the fastest parallel-port drives overall, keeping pace with the Avatar Shark 250 Mobile Hard Drive and the parallel-port SyQuest SyJet. This combination of size, speed, and affordability makes the SparQ an excellent choice.

The SyJet is what the company calls its professional-level drive. It offers enough capacity and performance to function as a hard disk supplement and to serve as a tool for archiving data and storing large multimedia presentations. You can even use it to boot up easily with different operating systems on different disks or as removable storage space for data you need to lock up every night. The 1.5GB disks cost \$66 each in a three-pack, for a very affordable cost of 4 cents per megabyte.

We tested both external versions of the drive (SCSI and parallel-port); there are also internal SCSI and EIDE versions. The only difference between the two external



SyQuest's EZFlyer, SparQ, and SyJet drives continue to set the price/performance standard in removable storage.

versions we tested is the cable. The SCSI version comes with a standard SCSI cable, while the parallel-port version comes with a SCSI-to-parallel-port conversion cable. Setting up either one is typical for the connection. For SCSI, you just plug the device in and boot up. For the parallel-port version, you install a driver as well. The utilities are nearly identical to those for the SparQ,

and they include the Visit utility for the parallel-port version.

Performance for the SCSI SyJet drive was a bit slower than for the EIDE SparQ but was still very much in the first tier. Performance for the parallel-port SyJet was among the fastest we found among parallel-port drives and was on a par with that of the parallel-port SparQ.

The SyJet drives share one other feature with the SparQ drives: They are among the best values in this roundup. They offer more capacity than any removable cartridge disk drive except the Jaz 2GB, at less than half the

price of the Jaz, and with comparable or better performance.—MDS

SyQuest EZFlyer 230 MB. Street price: \$150.

SyQuest SparQ 1.0 GB. Street price: \$200.

SyQuest SyJet 1.5 GB. Street price: \$300.

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"The fire fighters saved my family,
The Jaz Disk
saved my business."



STEPHEN TRIMM
Small Business Owner

When fire alarms woke the Trimms, Stephen's first concern was his family's safety. Next came the safety of his company, Innova Associates, based in the very home which was burning to the ground. However with his Jaz® drive and its sustained transfer rate of up to 6.62MB per second, days earlier, he had backed up his whole company (as much as 1 whole gigabyte in as little as 10 minutes) on a single Jaz disk. Despite the fact that his home was destroyed and his computer melted, his files remained safe on his amazing Jaz disk. Stephen's Jaz drive not only gives him the flexibility to run applications and files straight from disk, it's also compatible with nearly all operating systems. While rebuilding their lives remains a major task, Stephen rebuilt his business with the click of a button.

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Net Tools



Cyberfaxing

IP has spruced up faxing's image by adding intelligent routing and reducing phone costs.

By Les Freed

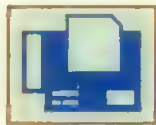
Fax isn't going away anytime soon, so you might as well optimize your company's use of fax technology and reduce phone costs at the same time. The four products in this roundup—the Brooktrout IP/FaxRouter, the Castelle Fax-Press 3500, the Omtool Fax Sr. 2.5, and the RightFAX Enterprise v5.0—all send fax documents over a public or private IP network rather than over a dial-up phone network. If you already have an IP network in place, these products can save you a few dollars each time someone sends a fax.

As a bonus, IP fax routers provide intelligent inbound and outbound fax routing. LAN users can send faxes from their desktops without the necessity of a fax modem or phone line on each PC. And they can receive faxes directly to their PCs. Two products reviewed here—Fax Sr. and RightFAX—also provide Web access that allows users to send and receive faxes via any Web browser. Three LAN-based fax products in this roundup also provide e-mail fax gateways that let incoming faxes appear as e-mail in a user's in-box. The gateways also allow e-mail users

INSIDE

FAX ON THE INTERNET:

IP faxing can greatly reduce phone costs for multilocation companies. Contributing editor Les Freed found four competent IP faxing solutions that can also perform functions like least-cost routing.



SOFTWARE DISTRIBUTION:

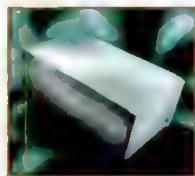
Intel LANdesk Configuration Manager eases large system deployment, according to contributor Kevin Young. Page 197.

DIRECTORY SERVICES:

And contributor Padraic Boyle finds that Novell's NDS for NT 1.0 offers an easy way to manage users in a hybrid IntranetWare/Windows NT environment from your NDS directory. Page 197.

SMALL-SCALE RAID:

Disproving RAID is for large-scale deployment only, contributing editor Steve Rigney discovers that Storage Dimension's RAIDPro LC is a cost-effective RAID solution for small networks. Page 198.



UNDER ATTACK: Even amateur hackers can execute simple denial-of-service attacks and wreak havoc on your network. Contributor Jeff Downey details a variety of attacks and how to prevent them. Page 203.

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Net Tools

INTERNET FAXING

to send faxes with their standard e-mail software.

All the products in this roundup except for the Brooktrout IP/FaxRouter are LAN-based. These products provide LAN users with shared access to inbound and outbound fax modems and phone lines; they also provide a consistent way to send and receive faxes over an IP network.

The Brooktrout IP/FaxRouter takes a different approach: It is a self-contained unit that can operate with any standard fax machine, PC fax program, or LAN-based fax tool. The Castelle FaxPress 3500 is a hybrid, a standalone box with built-in fax modems and an Ethernet interface that also uses storage and services on a Windows NT server. Fax Sr. and RightFAX run on a Microsoft Windows NT server and connect to the public phone network via a variety of third-party fax boards. Fax Sr. can also use standard internal or external fax modems. We tested Fax Sr. and RightFAX using Brooktrout's popular TR114 four-port LAN Fax card.

The Castelle, Omtool, and RightFAX products work best for companies that want to add LAN faxing and IP fax routing all in one package. These three products allow users to send faxes directly from their PCs. The Brooktrout IP/FaxRouter is best for companies that want to keep their existing fax infrastructures in place. IP fax tools are best for companies with several locations connected by a WAN. The more business locations you have, the greater the benefits of IP faxing.

IP fax solutions make use of a technique called least-cost routing (LCR). When you set up your fax servers, you build a table of area codes and WAN locations, and you tell

the fax software how to route calls to particular area codes. For example, if you had a fax server located in New York City, you would build the routing table to send all outbound fax calls to New York—vicinity area codes (such as 212 for Manhattan and 516 for Long Island) through the New York server. Similarly, a server in San Francisco would handle calls for the West Coast area codes. Once you've built the routing tables, the fax servers automatically route a fax; a user need only enter the destination's area code and phone number to have the server transmit the fax.

IP fax servers also route inbound faxes by using one or more techniques, including Direct Inward Dialing (DID), optical character recognition (OCR), and code routing.

DID is the most flexible and easiest to use, but it requires special DID phone lines (available from most phone companies) and a DID-capable fax modem. A single DID line is assigned to several phone numbers. When an incoming fax call rings the line, the phone company sends a code on the DID line that tells your equipment which number the caller dialed. The DID information allows the fax server to determine whom the fax is intended for; the server software routes the fax accordingly.

OCR doesn't use special phone lines but rather scans the first page of each fax looking for the characters "To:" followed by a name. The OCR software then routes the fax to the person named on the cover page. Code routing requires the sender to enter a three- or four-digit ID code after the fax modem answers. The fax software then routes the incoming fax to the person identi-

fied by the ID code.

If you would like to reap the benefits of IP faxing but do not have WAN-connected offices all over

the country, you may want to consider using a third-party Internet fax service provider such as SureFax (www.surefax.com), UNIFI (www.unifi.com), or Xpedite (www.xpedite.com).

Brooktrout Technology Inc.

Brooktrout IP/FaxRouter

All reviews by Les Freed

The Brooktrout IP/FaxRouter (\$4,995 list) provides an easy way to integrate your existing fax and IP networks. It connects from one to three phone lines; a conventional fax machine, a standalone PC fax modem, or an external LAN fax server; and your IP network. Although it provides excellent least-cost routing and IP/fax integration, unlike the other three products reviewed, the IP/FaxRouter isn't a LAN faxing tool—though it can act as an IP/fax router for any LAN fax product.

The product is a small standalone box, about the size and shape of an external CD-ROM drive, which contains its own CPU and hard disk. Unlike Castelle's external fax server, the IP/FaxRouter operates independent of your LAN file servers. The internal hard disk provides plenty of storage for incoming and outbound faxes, and the router's CPU handles inbound and outbound faxes without placing any burden on your file server or LAN.

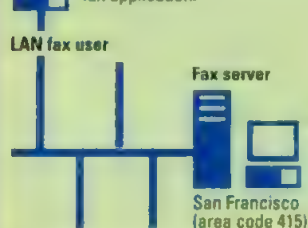
Installation was straightforward. We physically connected the IP/FaxRouter to a PC with the RS-232 cable provided. Using a terminal program on the PC, we followed a simple built-in menu system to set the product's IP address and basic configuration information. Once you set the IP address, you can use the Windows-based Central Network Management Software (CNMS) that Brooktrout provides to monitor and maintain all the IP/FaxRouters in your organization.

Each IP/FaxRouter in a network needs to know a great deal of information about the others. We liked that the software guided us through the daunting task of collecting and analyzing the routing and dialing information for the fax network.

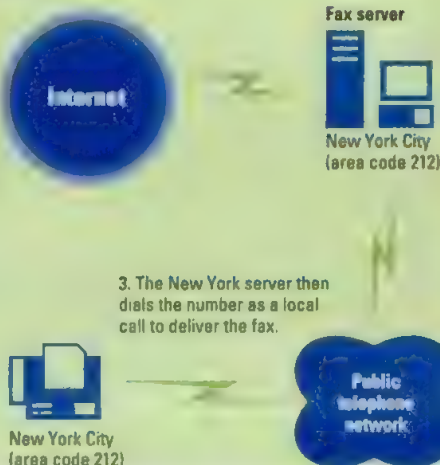
The IP/FaxRouter works with standard phone lines and fax machines, so it effectively links your existing fax machine and one or more phone lines. The IP/FaxRouter makes all its own routing decisions, so users don't have to do anything different to send a fax.

IP Faxing from the LAN

1. A San Francisco-based LAN user creates a document with a fax application.



2. The local fax server receives the fax and checks the area code of the destination phone number. Knowing that area code 212 is a local call from the New York City fax server, the server transmits the fax data via the Internet to the server in New York.



3. The New York server then dials the number as a local call to deliver the fax.

When we sent a fax from an attached fax machine, we heard the familiar dialing tones and fax answer sequence. And it doesn't matter what number you dial; the IP/FaxRouter actually answers the call and captures the transmitted fax to the router's hard disk. Behind the scenes, the IP/FaxRouter analyzes the number the user dialed and determines the least expensive way to retransmit the fax to the final destination.

When you dial a local number, the router simply dials out on one of the attached phone lines and retransmits the fax. If the destination number is outside your area code, the router transmits the fax via IP to the remote router that is physically closest to the area code you dialed.

We liked that the IP/FaxRouter also could relay incoming faxes on each of the attached phone lines. You simply opt to relay incoming faxes to the attached fax machine, or you instruct the IP/FaxRouter to forward incoming faxes to one of the other IP/FaxRouters on the IP network. Each attached phone line can have a different destination, so incoming calls on each line can be routed to a different person, a different department, or even an office in another city.

You can use the IP/FaxRouter with any LAN or PC-based fax program by simply connecting the fax modem or LAN fax server card to the IP/FaxRouter instead of a phone line. An optional application programming interface library lets users and developers create custom applications for the IP/FaxRouter. The toolkit includes dynamic link libraries files for Microsoft Windows 3.x, 95, and NT. In case you want to make your own program to run the router, Brooktrout provides examples in C.

Brooktrout IP/FaxRouter. List price: \$4,995. Brooktrout Technology Inc., Needham, MA; 800-333-5274, 781-449-4100; fax, 781-449-9009; www.brooktrout.com. Choose 903 at www.pcmag.com/infolink.

Castelle Inc.

Castelle FaxPress 3500

At first glance, the Castelle FaxPress 3500 (\$4,695 list for two lines, \$5,595 for four lines) appears very similar to the Brooktrout IP/FaxRouter. Both solutions connect to an IP network and to multiple phone lines, and both provide least-cost fax routing. But the similarities end there. Although Brooktrout's product operates as a standalone unit, the FaxPress, though it has its own internal fax modems and CPU, uses file and print services on a Windows NT or NetWare server to store and print fax traffic.

EDITORS' CHOICE

• RightFAX Enterprise v5.0



All of the IP fax products included in this roundup are capable of servicing the needs of large companies with multiple locations. With the exception of the

Brooktrout IP/FaxRouter, all give end users a fax-generating application as well as shared access to inbound and outbound fax modems and phone lines. But RightFAX Enterprise v5.0, the most complete solution we reviewed, simply works the best, earning it our Editors' Choice. The software-based RightFAX was the easiest solution to install; it took a mere 30 minutes and worked on the first try. And at \$2,995 for unlimited users, it carries a low price, though the other more expensive products in this roundup include hardware in their sticker prices. We liked the variety of routing

options and the Web Client option, which allows users Web-based access to faxes.

An honorable mention goes to the Castelle FaxPress 3500, a hybrid solution that features a standalone box with fax modems built-in and an Ethernet interface. It accommodates inbound and outbound faxes from other FaxPress units as well as conventional fax machines and other LAN users. The product's FaxMain program makes it easy to configure phone lines, user privileges, and fax routing. But because there are numerous options available, using FaxMain requires some advance planning.

In return, the FaxPress delivers an impressive and complete set of network faxing tools: It handles inbound and outbound faxes from LAN users, conventional fax machines, and other Castelle FaxPress 3500 units on an IP or IPX network. We could send faxes directly from applications using Castelle's LAN fax printer driver or to Castelle's standalone fax program FaxMain. Optional software add-

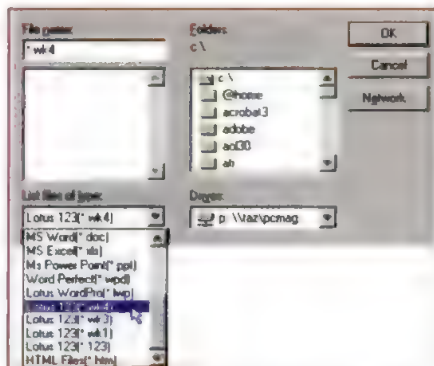
phone lines, an Ethernet connection, and connections for serial and parallel printers. While we thought serial and parallel connections seemed like an odd thing for a fax server, they allowed us to connect an inexpensive printer dedicated to fax-receive duty.

To install the FaxPress, we connected the unit to our phone lines, LAN, and printer and installed the FaxPress server and client software on a Windows NT or NetWare server on our LAN.

Once we installed the software, we used FaxMain to configure phone lines, user privileges, and fax routing. We found FaxMain easy to use, but it required some planning to sort through all of the available options.

The FaxPress software can restrict fax access to specific users. We were able to create a user database with FaxMain or use Windows NT groups and domains to control user access. Each user may have an optional inbound ID code so callers can route inbound faxes to a specific FaxPress user. The caller simply dials the ID code after the FaxPress answers an incoming fax call. The FaxPress also allows inbound fax routing based on DID (Direct Inward Dialing) on DID-enabled lines. Inbound fax routing can also be based on DTMF (dual-tone multiple frequency), which requires the fax sender to add a routing code.

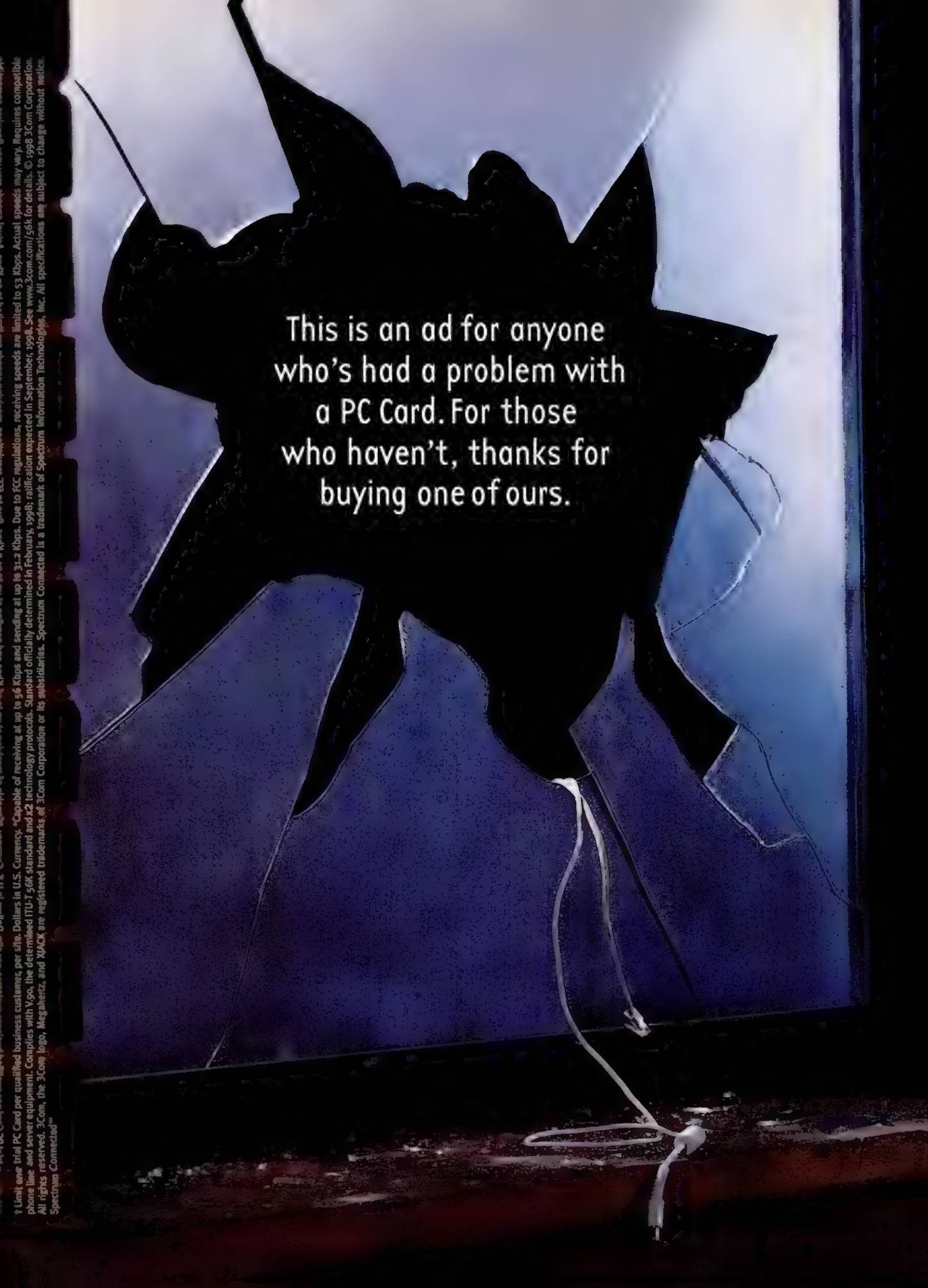
LAN users can send outbound faxes using FaxMain or with Castelle's fax printer driver.



FAXING VERSATILITY: FaxPress can handle hundreds of popular application attachments.

ons let you fax from popular groupware and e-mail programs, including Lotus Notes and cc:Mail and Microsoft Exchange. The FaxPress also works with the HP Network Scanner Jet 5 LAN scanner.

Physically, the FaxPress is nothing special, just a gray metal box about the size of a small PC chassis. The FaxPress has jacks for four



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Net Tools

INTERNET FAXING

Two other options exist for outbound faxing. The drop directory method, a third-party integration tool, allows users to create a program that interfaces with the FaxPress. The second option is Castelle Procedural Interfacing (CPI). Programmers call CPI subroutines to access the FaxPress unit.

The printer driver allows LAN users to send faxes directly from virtually any application. Like most PC fax programs, the print driver renders the print output into fax-compatible format. Both the printer driver and FaxMain let us add a cover page to any outgoing fax and retrieve commonly used fax numbers from a shared or private database of numbers.

We found the attach feature especially useful, since it can read about 200 different types of files, including most popular word processor, spreadsheet, database, and graphics formats such as Microsoft Excel, PowerPoint, and Word and WordPerfect.

The FaxPress uses Castelle's own Castelle Internet Faxing (CIF) protocol for IP fax routing over public or private IP networks. It also employs Castelle's Third-Party Internet Faxing (TIF) protocol for faxing via TIF-enabled Internet service providers.

Castelle offers other versions of the FaxPress, including the single-line 1500 for \$2,995. Castelle and 3Com jointly market the \$1,695 Castelle OfficeConnect Fax Server. **Castelle FaxPress 3500.** List price: 2 lines, \$4,695; 4 lines, \$5,595. Castelle Inc., Santa Clara, CA; 800-289-7555, 408-496-0474; fax, 408-492-1964; www.castelle.com. Choose 904 at www.pcmag.com/infolink.

Omtool Ltd.

Omtool Fax Sr. 2.5

Omtool Fax Sr. 2.5 (\$4,995 list) provides a well-rounded suite of LAN, Internet, and intranet fax tools for Microsoft Windows NT Server. The software-based solution comes standard with an e-mail-to-fax gateway—an extra-cost option in most other LAN fax products. Fax Sr. also includes client software for Windows 3.x, 95, and NT, Macintosh, and DOS. In addition to the typical LAN fax client, Fax Sr. provides a Web interface that lets you send and receive faxes from any browser.

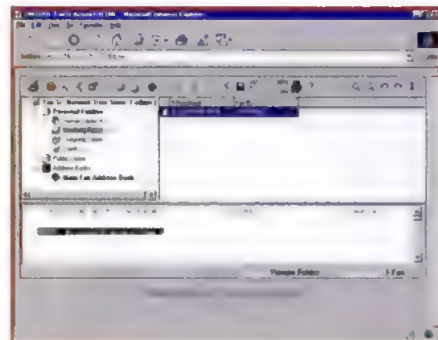
Fax Sr. runs on Windows NT Server 4.0 or NT Workstation 4.0 and operates over a TCP/IP, IPX/SPX, or NT File Services connection. Fax Sr. works with each of a select group of external fax modems (the Multi-Tech series, ZyXEL series, and U.S. Robotics Sportster) attached to a serial port; it also works with multiport fax cards from Brooktrout and Dialogic

Corp.'s GammaLink. Omtool provides the necessary drivers for both cards in the Fax Sr. box. We tested Fax Sr. using TCP/IP with one Brooktrout TR114 four-port fax card and one Sportster external fax modem.

Like most LAN fax products, Fax Sr. is complex: The product has literally hundreds of options and features. We were pleased to find that Omtool's user manuals are some of the best we've seen for any product. Four spiral-bound manuals cover the server and client installation, faxing via e-mail, and system management. The manuals are well written, with plenty of screenshots and explanatory diagrams.

All of the Fax Sr. software is supplied on a single CD-ROM. It took us about an hour to install our test server, including the time we needed to install the Brooktrout card and associated drivers. The server installation program copies the Fax Sr. client software to a shared directory, so LAN users can install the client without the CD-ROM. The installer also creates a Fax Sr. virtual printer on the server, but you must manually create a LAN share for the virtual print server before others can use it.

Once we installed the Fax Sr. server software, we used the Fax Sr. System Manager to install and configure modems, set routes for incoming and outbound faxes, and monitor activity. We liked the System Administrator program. It includes a useful activity analysis tool, the Activity Monitor, which displays



A FAMILIAR FACE: Fax Sr.'s Web-based client and its Windows counterpart function the same.

several bar graphs showing fax activity and traffic levels. Although the System Administrator functioned perfectly in our testing, it often operated sluggishly, even on a 300-MHz Pentium II PC.

The client installation took only a few minutes, but it has to be done on every PC that

SUMMARY OF FEATURES

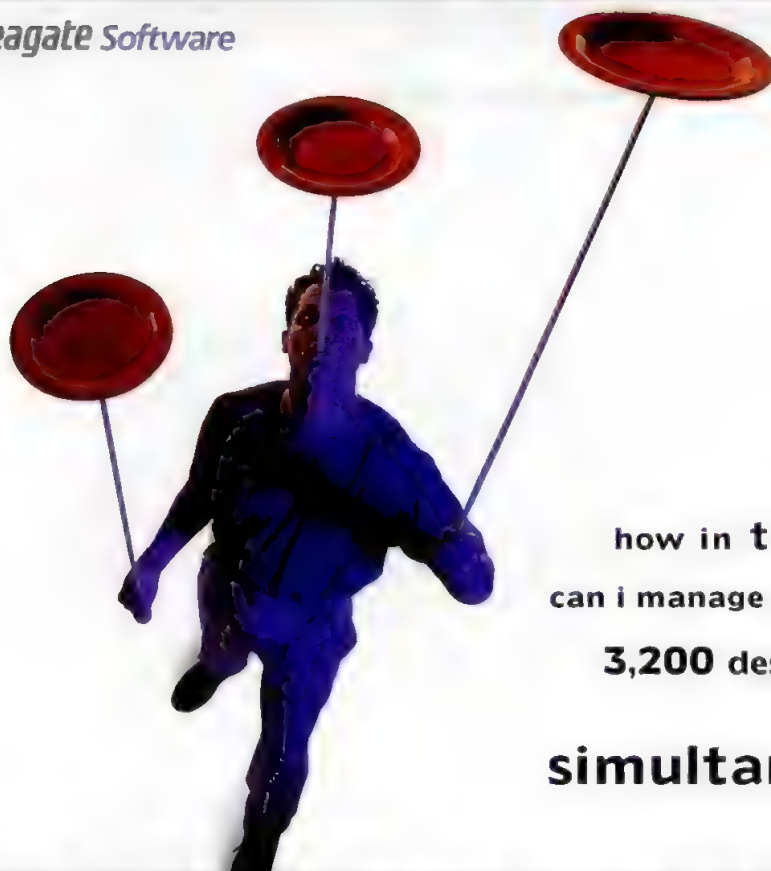
Internet Faxing

	Brooktrout IP/FaxRouter	Castelle FaxPress 3500	Omtool Fax Sr. 2.5	RightFax Enterprise 5.0
■ YES ■ NO □ OPTIONAL				
List price	\$4,995	\$5,595	\$4,995	\$2,995
Product type	Standalone	Hybrid	Server-based	Server-based
Maximum number of lines per server/users	4 / Unlimited	4 / Unlimited	Unlimited / Unlimited	48 / Unlimited
Supports external modem/third-party fax server	N/A ¹	N/A ¹	■ ■	■
Supports Windows NT/NetWare	■ ■	■ ■	■ ■	■ ■
Client OS				
Windows 3.x/95/NT	N/A ²	■ ■ ■	■ ■ ■	■ ■ ■
DOS / OS/2 / Mac OS	N/A ²	■ ■ ■	■ ■ ■	■ ■ ■
Fax Boards Supported				
Brooktrout/GammaFax	N/A ¹	N/A ¹	■ ■	■ ■
Wildcard	N/A ¹	N/A ¹		
LAN Fax Client Type				
Standalone program	N/A ¹	■	■	■
Printer driver/Web browser	N/A ²	■	■ ■	■ ■
E-Mail Interface				
GroupWise	N/A	□	■	■
Lotus cc Mail/Notes	N/A ²	□ □	■ ■	■ ■
Microsoft Mail/Exchange	N/A	□ □	■ ■	■ ■
POP3 and SMTP	N/A ²	□	■	■
Inbound Call-Routing Options				
DID/Touch-tone/OCR	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Caller ID/ISDN caller ID	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■

¹ The product works over any IP network. N/A¹—Not applicable. The product has built-in modems.
N/A²—Not applicable. The product relies on a third-party fax application.

PC MAGAZINE
EDITOR'S CHOICE

 **Seagate Software**



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needs fax access. The Client Installer program sets up the Fax Sr. standalone fax client, a virtual print driver for printing to the fax server, a fax viewer, an incoming fax notification program, and Fax Merge capabilities that add a Print to Fax toolbar button and menu selection to your Windows-based applications.

We found Fax Sr.'s Web access to be one of the program's most appealing features. Like RightFAX Enterprise v5.0, Fax Sr. creates a Web page that you publish with only Microsoft Internet Information Server 4.0. Internet and intranet users are able to connect to the Web page with any Java- or ActiveX-capable browser to send, receive, and monitor faxes. The Web-based interface provides the same functionality as the standalone fax client, and we actually preferred the browser's user interface to that of the Windows-based client.

Fax Sr. includes e-mail gateways for Microsoft Exchange and Mail, Lotus Notes and cc:Mail, and SMTP mail servers. The gateway software lets e-mail users send e-mail messages via fax and also lets fax users send faxes to others via e-mail.

Like the other products in our roundup, Fax Sr. can perform least-cost routing (LCR) over an IP network. But to use LCR, you need two or more Fax Sr. systems in separate locations.

Fax Sr. uses phone number pattern matching to determine fax routing, and a fail-safe mode sends outbound faxes over the public telephone network if the WAN connection goes down. Fax Sr. can route incoming faxes based on DID, DTMF, and OCR. Fax Sr. can also connect to third-party fax-routing services from SureFax, UNIFI, and Xpedite.

Omtool Fax Sr. 2.5. List price: Unlimited users, \$4,995. Omtool Ltd., Salem, NH; 800-886-7845, 603-898-8900; fax, 603-890-6756; www.omtool.com. Choose 905 at www.pcmag.com/infolink.

RightFAX Inc.

RightFAX Enterprise v5.0



Of all the products in this roundup, the software-based RightFAX Enterprise v5.0 (\$2,995 list for unlimited users) is arguably the most complete. RightFAX Enterprise provides LAN faxing (both as a printer driver and as a standalone application), inbound and outbound fax routing, optical character recognition for incoming

Net Tools

INTERNET FAXING

faxes, and an excellent Web-based fax tool. It earned our Editors' Choice. Though scattered across several programs and control-panel ap-

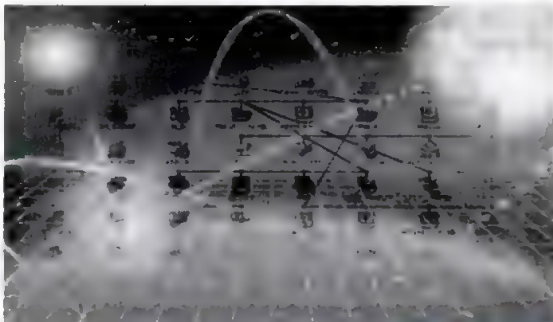
plets, RightFAX Enterprise's administration and configuration interface was the easiest to use of the products we tested. The basic RightFAX Enterprise package includes a license to run the server with two phone lines; additional phone line licenses are \$795 each. According to RightFAX, the product supports up to 48 fax ports in a single server.

We found that installation, too, was the easiest of all the products in our roundup, thanks in large part to RightFAX Enterprise's ability to sniff out installed LAN Fax cards. RightFAX Enterprise works with multiport fax modem cards from Brooktrout and GammaLink (a subsidiary of Dialogic Corp.) but not with standard external fax modems. We needed only 30 minutes to install the product on our test server, and it worked perfectly on the first try. RightFAX Enterprise can selectively import user names from a Windows NT user database, so you don't have to spend much time setting up user accounts.

During installation, we chose the confus-

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- **IPS** uses existing Windows printer drivers and therefore allows printing from any application to any printer on your LAN or the Internet.

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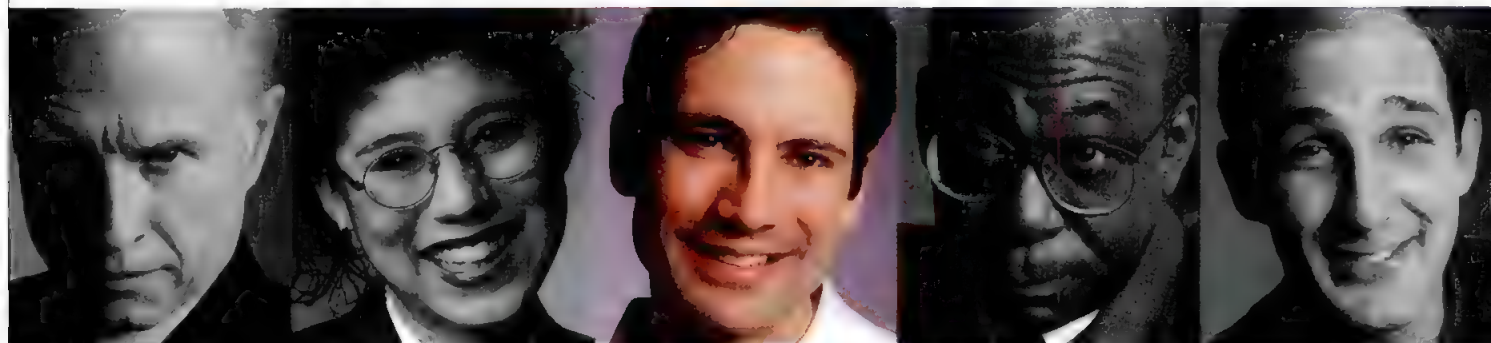


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Net Tools

INTERNET FAXING

ingly named RightFAX Enterprise Web Client option (\$1,295). The Web Client is actually a set of Web pages that work with just Microsoft Internet Information Server to provide Web-based access to inbound, outbound, and archived faxes. RightFAX provides sample HTML code to help you integrate RightFAX Enterprise into your existing Web page, so RightFAX Enterprise Web pages can coexist with a Web server on the same Windows NT server.

RightFAX Enterprise offers a complete suite of call-routing options for both inbound and outbound faxes. The RightFAX Enterprise LCR module automatically routes faxes among several RightFAX Enterprise servers on an IP or IPX/SPX network. RightFAX Enterprise LCR can also route faxes to enhanced fax service providers (EFSPs). If you're sending faxes over a public Internet link, RightFAX Enterprise can use Remote Procedure Call (RPC) to encrypt the fax data to help insure privacy. A set of route-tracing and routing-rule testing tools let us check our routing configuration for errors.

We found outbound call-routing options easy to set up, and we could specify different

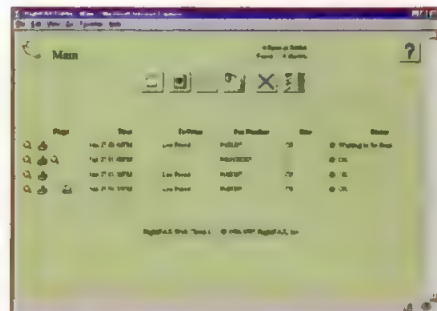
routing for different users. For example, we could require some users to route their faxes through a manager; the manager would

then approve the fax before it was sent. Similarly, we could set up a group of low-priority users whose outbound faxes would be sent after normal business hours when phone costs are lower. Any individual phone line can be designated as dial-in, dial-out, or both, and you can change the status of each phone line manually or on a predefined schedule. This lets you to reserve most lines for inbound faxes during the day and then switch them to outbound-only duty after hours.

Users can choose from three RightFAX Enterprise clients. The product installs a standard Windows NT printer queue that routes printed output to the RightFAX Enterprise server. A dedicated fax program, FaxUtil, let us send faxes, view received faxes, and check the status of outbound faxes. Finally, we were able to use a Web browser to access the RightFAX Enterprise Web interface, which provides essentially the same features as FaxUtil. The Web interface lets users upload files (in 45 formats) to transmit as fax documents. We transmitted BMP, Microsoft Excel and Word 97, and plain-

text files as faxes with no surprises.

RightFAX Enterprise includes e-mail gateways for Internet mail servers (with SMTP/POP3 protocols), Lotus cc:Mail and Notes, Microsoft Mail and Exchange, and Novell's GroupWise. By the time you read



WEB FAXING: RightFAX's Web client lets you access faxes from your browser.

this, RightFAX will be releasing RightFAX Enterprise v5.2.

RightFAX Enterprise v5.0. List price: Unlimited users (server license and two channels), \$2,995; each additional channel, \$795. RightFAX Inc., Tucson, AZ; 888-320-7778, 520-320-7000; fax, 520-321-7456; www.rightfax.com. Choose 906 at www.pcmag.com/infolink.com. **PC**

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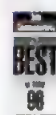
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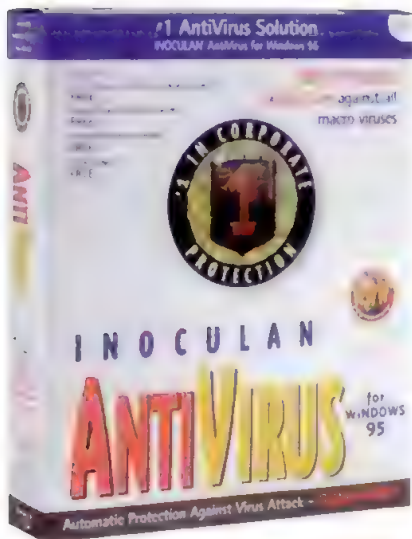
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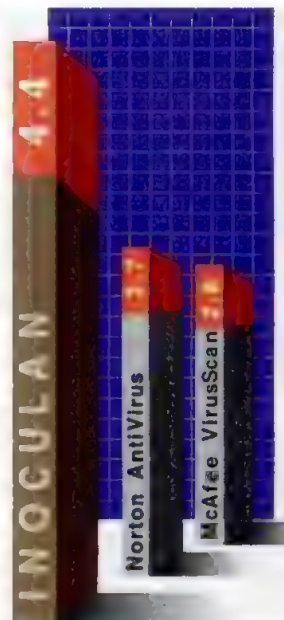
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FROM THE BENCH

A Tree Grows in NT

Managing users in a hybrid IntranetWare/Microsoft Windows NT environment from a single console used to mean investing in third-party metadirectory products, such as NetVision's

server with NDS must be present on the network. But Novell's next rendition, NDS for NT 1.1 (due out by the middle of this year) will eliminate that requirement, so that NDS will run purely on the Windows NT-server platform.



Synchronicity for NT. But now, Novell's NDS for NT 1.0 lets you manage Windows NT users from Novell's NDS (NetWare Directory Services) database without using a third-party product. NDS for NT is simple to install and use, but the sticker price may shock you: For a 250-user license, the per-seat cost is \$65 (list). By contrast, Synchronicity for NT runs from \$4 to \$14 (list) per seat. To help ease the price burden, Novell offers discounts to contract license holders.

The product's name is a bit misleading. NDS for NT is designed for an environment using both IntranetWare and Windows NT servers. At least one NetWare

NDS for NT installs on the Windows NT platform just like any third-party application. NDS for NT tweaks the Samsrv.dll, which provides authentication and security for Windows NT's Security Accounts Manager (SAM), to redirect all authentication requests destined for the SAM database to the NDS database stored on a NetWare server. Thus, users on the NDS tree can access a Windows NT domain and its resources. Because of the redirection design, though, none of the users created under NDS are replicated into the SAM database.

In case you want to remove NDS for NT from your Windows

NT server, Novell's migration wizard offers two options: You can return to the original Windows NT configuration or move users created under NDS for NT to the SAM database. Either way, Windows NT returns to its original security management structure.

After NDS for NT is installed, all management processes for both IntranetWare and Windows NT are performed from NWAdmin, Novell's graphical management platform. But to use NDS for NT's snap-in module, NWAdmin must be run from a Windows NT workstation connected to the LAN. Administrators using Windows 95 can see the Windows NT domain and groups but cannot modify them.

To ease configuration, Novell provides a wizard to integrate a Windows NT domain and its users and groups into your existing NDS structure. In our test environment, this step was fast and painless. But a hassle-free installation requires careful planning and the proper information, such as which NDS tree and organizational unit the Win-

Configuration Made Easy

Rolling out 50 new desktops can cause any IS technician to gnash his teeth, but the hardware-based Intel LANDesk Configuration Manager 1.5 (LCM) takes the bite out of massive system deployments. The LCM goes beyond normal ghosting and hard disk duplication and allows you to personalize each sys-

dows NT domain will be placed under. Even after the users are in the NDS tree, NWAdmin can be used to move users to their respective NDS organizational units.

Worth noting is that Microsoft recently announced it will support NDS for NT. Originally Microsoft was opposed to supporting the product, but the company later agreed to treat NDS for NT like any other third-party application. Microsoft claims, however, that NDS for NT diminishes Windows NT security and that whoever uses it will have difficulty migrating to Windows NT 5.0. With its tepid support of NDS for NT, Microsoft is likely hoping to buy some time to lure people back when Active Directory ships with Windows NT 5.0 later this year. Novell claims that future releases of NDS for NT will support Windows NT 5.0.

NDS for NT 1.0. List price: 250-user license, \$65 per seat. Novell Inc., Orem, UT; 800-453-1267, 801-222-6000; fax, 801-429-5291; www.novell.com. *Choose 901 at www.pcmag.com/infolink.*

toolkit. Later this year, Intel plans to release a software-based version of the LCM for about a tenth of the LCM's current price.

In its latest incarnation, the LCM has been upgraded to a 200-MHz Pentium Pro processor with 64MB of RAM and an Intel EtherExpress PRO/100B Adapter. Unlike the LCM 1.0 software, which runs only on Microsoft Windows



NT 3.51, the LCM 1.5 software runs only on Windows NT 4.0. With this configuration, Intel suggests that the LCM can handle around 50 active machines at a time, depending on your specific network. On the client side, you can create a connection to the LCM either by using a boot ROM on the network adapter or by using a floppy disk. Currently, few network adapters can use the boot ROM method. But by using floppy disks, you increase the number of adapters you can select to 20 or so.

We set up several machines, erased their hard disks, and then used the LCM to format the disks and distribute Windows 95 or NT Workstation to each. In most cases, our initial attempts were unsuccessful, which we expected. Intel is not shy about dismissing the notion that the LCM will simply drop into your network and fix all of your deployment problems. The company recommends that you devise a careful deployment strategy and perform extensive pretesting of deployment packages before the actual rollout. Intel also suggests that when you buy the product, you schedule a day or two of consultation with your channel reseller. After some fine-tuning with the help of an Intel engineer and the addition of the proper network adapter driver (Intel EtherExpress 100B) for our client machines, our deployments worked flawlessly time after time.

The LCM also offers software

Net Tools

FROM THE BENCH

distribution and some network management. In fact, the LCM includes a scaled-down version of LANdesk Management Suite 6.0, Desktop Manager. As a network management platform, it lets you perform basic tasks such as remote hardware inventory and remote control, so you can fix client problems from a central location. But the LCM is not powerful enough to serve as a true standalone management platform. Unfortunately, these additional features are not among its strengths (for more information, see "TKO Your TCO Today," October 21, 1997).

It's important to point out that the LCM excels at initial OS distributions and not at secondary software-distribution capabilities. We do not recommend the LCM for those who are interested in the latter, because it has a very specific purpose and few peripheral abilities. Software distribution products such as Intel LANdesk Management Suite 6.0 or Microsoft System Management Software are good complements to the LCM's OS distribution ability. **Intel LANdesk Configuration Manager 1.5.** List price: \$9,995. Intel Corp., Santa Clara, CA; 800-548-4725, 408-765-8080; fax, 408-765-1821; www.intel.com. Choose 900 at www.pcmag.com/infolink.

CROSS TALK



Frank Dorfner

So many tools, so little time. Determining when it is worth introducing a new way of doing things is a tricky matter in networking. Do you introduce centralized OS upgrades using a product such as Intel's LCM, or do you continue to do upgrades by walking around? These are questions of corporate style as well as economics.

It's a matter of volume, Frank. At some point, the overhead of doing individual updates and upgrades will force a centralized solution. You trade a lot of overhead all the time for a lesser amount of overhead at certain times. At least that's the hope. In networking, management is a hard thing to cost-justify.



Leon Erlanger

RAID STORAGE

Storage for Less

By Steve Rigney

Trying to dismiss the notion that hardware-based RAID solutions are too expensive for small networks, Storage Dimensions recently released the Storage Dimensions RAIDPro LC. It is the entry-level model of the company's RAIDPro family. The RAIDPro LC, which starts at \$4,990 (list), is a relatively low-cost solution com-

Smart2-SL Array Controller.

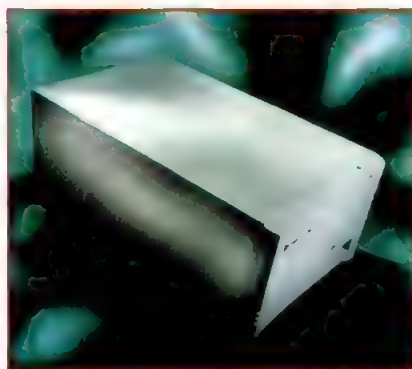
To set up the RAIDPro LC, we simply installed the Dynamic Growth and Reconfiguration (DGR) array controller in our Gateway NS 7000 server and loaded the Windows NT drivers. The DGR included with the package is a single-channel Fast/Wide SCSI 2 controller with 16MB of on-board cache and is expandable up to 64MB.

You can configure the RAID system by using the BIOS setup utility when you first start the PC or by employing the character-based RAID Manager utility. The BIOS setup is our favorite method, because it lets you set up the RAID system before installing or launching the OS. But if you want to change settings without

downing the server, then the RAID Manager, which runs as a NLM under NetWare or as a character-based utility under Windows NT, is your best bet.

We liked that the DGR controller could add disk space and change RAID levels at a moment's notice. We were able to insert a disk drive and change the RAID level from Level 1 to Level 5 without downing the server or affecting users' access to data. Note that you can't change from just any level to a new level. You can change only certain RAID levels, such as Level 1 to Level 5, Level 3 to Level 0, or Level 5 to Level 0, without downing the system and performing a rebuild. The limits are imposed by the nature of the RAID levels and not the product.

Storage Dimensions RAIDPro LC. List price: With 3 hard disks, \$4,990. Storage Dimensions, Milpitas, CA; 800-765-7895, ext. 900; 408-954-0710; fax, 408-944-1200; www.storagedimensions.com. Choose 902 at www.pcmag.com/infolink. **PC**

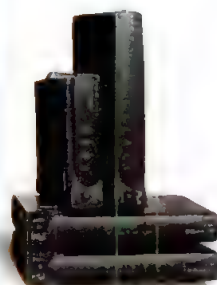
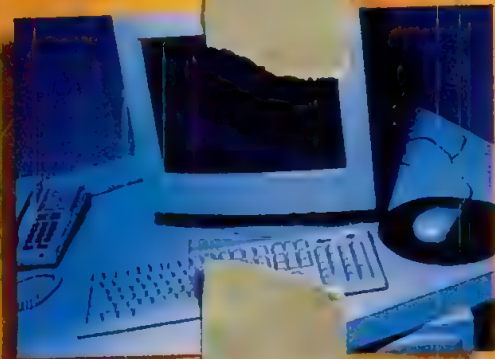


The RAIDPro LC provides easy scalability and on-the-fly RAID-level transition.

posed of a PCI-caching RAID controller, a six-bay external chassis, three hot-swappable redundant power supplies, and two hot-swappable cooling fans. The product works with Windows NT 3.51 and 4.0 and NetWare 3.x and 4.x and supports RAID Levels 0, 1, 3, and 5. We were impressed by its ability to change RAID levels on the fly.

The desktop PC-size RAIDPro LC includes six drive bays, which you can populate with Seagate 5,400-rpm 4.3GB hard disks, for a total of 25.8GB of disk space using RAID Level 0 or 21.5GB using RAID Level 5. The chassis also includes several handy LEDs, which provide simple status information for the unit. All components in the RAIDPro LC, including the hard disks, power supplies, and cooling fans, are hot-swappable, which means you can replace them without taking the system off-line. We know of only one other solution that lets you add hard disks with the system online: the Compaq

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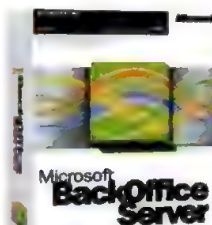
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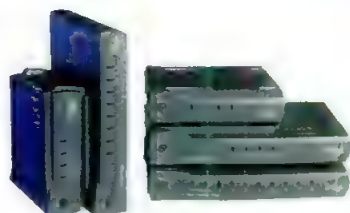
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INTERNET TOOLS

DENIAL-OF-SERVICE ATTACKS

Can't Say No



By Jeff Downey

Smurf. Teardrop. Land. These may sound like nicknames for new Spice Girls but they're much more deadly. All are software programs designed to wreak havoc with your Internet devices and networks. The "denial-of-service" (DoS) attack agents are so simple to execute that they've grown increasingly popular with hacker wanna-bes. Still, for every known attack there is an effective countermeasure recommended either by vendors or by the Computer Emergency Response Team

(CERT) to help you secure your networks against current and future denial-of-service attacks. But you must stay current and informed.

DoS attacks are aimed at devices and networks with exposure to the Internet. Their goal is to cripple a device or network so that external users no longer have access to your network resources. Without hacking password files or stealing sensitive data, a denial-of-service hacker simply fires up a program that will generate enough traffic to your site that it denies service to the site's legitimate users.

KNOWING YOUR ENEMY

There are three types of DoS attacks: those that exploit a bug in a TCP/IP implementation, those that exploit a shortcoming in the TCP/IP specification, and brute-force attacks that clog up your network with so much useless traffic that no other traffic can get in or out.

Two lethal attacks, the well-known Ping of Death and the newer Teardrop attack, exploit known bugs in TCP/IP implementations. The **Ping of Death** uses a ping system utility to create an IP packet that exceeds the maximum 65,536 bytes of data allowed by the IP specification. The oversize packet is then sent to an unsuspecting system. Systems may crash, hang, or reboot when they receive such a maliciously crafted packet. This attack is not new, and all OS vendors have fixes in place to handle the oversize packets. (See the table "OS Vulnerabilities to DoS Attacks.")

The recently developed **Teardrop** attack exploits weaknesses in the reassembly of IP packet fragments. During its journey through the Internet, an IP packet may be broken up into smaller chunks. Each fragment looks like the original IP packet except that it contains an offset field that says, for instance, "This fragment is carrying bytes 600 through 800 of the original (non-fragmented) IP packet." The Teardrop program creates a series of IP fragments with overlapping offset fields. When these fragments are reassembled at the destination host, some systems will crash, hang, or reboot.

Weaknesses in the TCP/IP spec-

ification leave it open to **SYN** attacks, executed during the three-way handshake that kicks off the conversation between two applications. Under normal circumstances, the application that initiates a session sends a TCP SYN synchronization packet to the receiving application. The receiver sends back a TCP SYN-ACK acknowledgment packet and then the initiator responds with an ACK acknowledgment. After this handshake, the applications are set to send and receive data.

But a SYN attack floods a targeted system with a series of TCP SYN packets. Each packet causes the targeted system to issue a SYN-ACK response. While the targeted system waits for the ACK that follows the SYN-ACK, it queues up all outstanding SYN-ACK responses on what is known as a backlog queue. This backlog queue has a finite length that is usually quite small. Once the queue is full, the system will ignore all incoming SYN requests. SYN-ACKs are moved off the queue only when an ACK comes back or when an internal timer (which is set at relatively long intervals) terminates the three-way handshake.

A SYN attack creates each SYN packet in the flood with a bad source IP address, which under routine procedure identifies the original packet. All responses are sent to the source IP address. But a bad source IP address either does not actually exist or is down; therefore the ACK that should follow a SYN-ACK response will never come back. This creates a backlog queue that's always full, making

OS Vulnerabilities to DoS Attacks

■ VULNERABLE ■ NOT VULNERABLE

DoS attack	Windows 95	Windows NT 4.0	Sun Solaris	Digital Unix	AIX 4.2	SCO OpenServer	Linux	FreeBSD	Countermeasures
Land	■	■	■	■	■	Unknown?	■	■	Filter out bad source IP addresses
Ping Of Death	■	■	■	■	■	■	■	■	Filter the ICMP echo packets
Smurf	■	■	■	■	■	■	■	■	Filter the ICMP echo packets
SYN	■	■	■	Unknown?	■	Unknown?	■	Unknown?	—
Teardrop	■	■	■	■	■	Unknown?	■	■	—
UDP Flood	■	■	■	■	■	■	■	■	Filter UDP service packets or disable UDP services

(1) Vulnerability to this attack can be eliminated. See www.cert.org for more information.

(2) CERT has no information about the attack's effect on this OS.

it nearly impossible for legitimate TCP SYN requests to get into the system.

Firewall vendors such as Checkpoint, Cisco, and Raptor have incorporated features into

their products to shield your downstream systems from SYN attacks. In addition, your firewall should make sure that outbound packets contain source IP addresses that originate from your

Net Tools

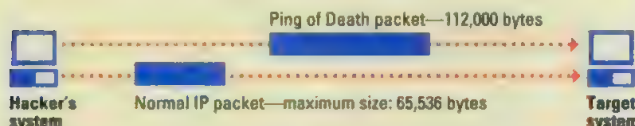
INTERNET TOOLS

Denial-of-Service Attacks

Unlike older hacker attack techniques, which try to destroy or corrupt your data, denial-of-service attacks aim to prevent your network from accessing the Internet by bringing down your firewall or proxy server.

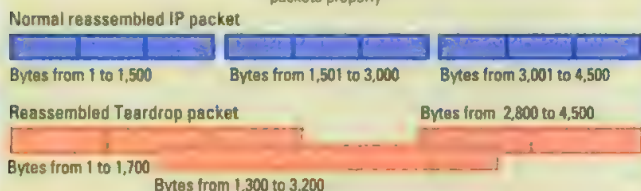
A KILLER PACKET

In a Ping of Death attack, the hacker uses a packet that is larger than the 65,536-byte maximum the IP standard allows. When the victim's systems encounter a packet of this size, they can crash, hang, or reboot.



THE PIECES JUST DON'T FIT

The Teardrop attack exploits IP's packet reassembly feature by creating packet fragments with overlapping offset fields, making it impossible for the target system to reassemble the packets properly.



TWO OUT OF THREE IS BAD

A SYN attack exploits IP's three-way handshake model. By only initiating the handshake and not responding to the second portion, the attack forces the target system to store acknowledgment packets in its finite-size backlog queue until the queue overflows and will not acknowledge any more requests.



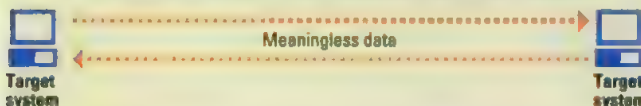
A PING PASS

A Smurf attack happens when a hacker spoofs the target system's IP address and then broadcasts a ping request to several subnets. The resulting deluge of ping responses ties up the victim's system as well as the various network subnets pinged.



GOING NOWHERE FAST

A hacker creates a UDP Flood by connecting an unsuspecting system's UDP character-generating service, chargen, to another unsuspecting system's UDP echo service. Once the link is made, the two systems are tied up exchanging a flood of meaningless data.



internal network, so that source IP addresses can't be forged (or spoofed) from the network.

In a Land attack—a simple hybrid of the SYN attack—hackers flood SYN packets into the network with a spoofed source IP address of the targeted system. Even with SYN fixes in place, a Land attack can cause problems for some systems. Although this type of attack is new, most OS vendors provide fixes.

Another way to defend your network against the Land attack is to have your firewall filter out all incoming packets with known bad source IP addresses. Packets that come into your system with source IP addresses that identify them as generated from your internal system are obviously bad. Filtering packets will neutralize exposure to the Land attack. Among the known source IP addresses that you should filter are 10.0.0.0 to 10.255.255.255, 127.0.0.0 to 127.255.255.255, 172.16.0.0 to 172.31.255.255, and 192.168.0.0 to 192.168.255.255.

A lot more dangerous than any initiative launched by their cartoon namesakes, the Smurf attack is a brute-force attack targeted at a feature in the IP specification known as direct broadcast addressing. A Smurf hacker floods your router with Internet Control Message Protocol (ICMP) echo request packets (pings). Since the destination IP address of each packet is the broadcast address of your network, your router will broadcast the ICMP echo request packet to all hosts on the network. If you have numerous hosts, this will create a large amount of ICMP echo request and response traffic.

If a hacker chooses to spoof the source IP address of the ICMP echo request packet, the resulting ICMP traffic will not only clog up your network—the “intermediary” network—but will also congest the network of the spoofed

source IP address—known as the “victim” network.

To prevent your network from becoming the intermediary, you can turn off broadcast addressing if your router allows it (unless you need it for multicast features, which haven't been fully defined yet), or you can let your firewall filter the ICMP echo request. To avoid becoming the victim of a Smurf attack, you must have an upstream firewall—preferably a border router—that can either filter ICMP echo responses or limit echo traffic to a small percentage of overall network traffic.

The User Datagram Protocol (UDP) Flood denial-of-service attack also links two unsuspecting systems. By spoofing, the UDP Flood attack hooks up one system's UDP chargen service, which for testing purposes generates a series of characters for each packet it receives, with another system's UDP echo service, which echoes any character it receives in an attempt to test network programs. As a result, a nonstop flood of useless data passes between the two systems.

To prevent a UDP Flood, you can either disable all UDP services on each host in your network or—easier still—have your firewall filter all incoming UDP service requests. Since UDP services are designed for internal diagnostics, you could probably get by with denying UDP service access from the Internet community. But if you categorically deny all UDP traffic, you will rebuff some legitimate applications, such as RealAudio, that use UDP as their transport mechanism.

FOREWARNED IS FOREARMED

The best way to keep your network secure from future DoS attacks is to subscribe to the CERT mailing list. CERT (www.cert.org) is a part of the Software Engineering Institute at Carnegie Mellon University and keeps its finger on the pulse of the Internet hacker community. The organization will notify you when new Internet weaknesses emerge. **PC**

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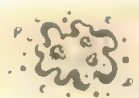
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PC Tech



Building Scalable Apps

Microsoft Transaction Server simplifies the process of building scalable, distributed applications.

By John Lam

Implementing truly scalable client/server systems is very difficult. During the process of building such a system, you encounter some of the thorniest programming problems. You have to contend with writing thread-safe code, managing communications sessions efficiently, minimizing the amount of network traffic generated by your code, and ensuring that contention for server and database resources is kept to a minimum. Throw security into this mix and you have a recipe for writing reams of code that bears little or no relationship to the business problem you are trying to solve.

All these problems are encountered over and over again across a very large number of client/server applications. And since we would all like to minimize the amount of code we have to write—and subsequently test—this is an area that is ripe for innovation. Ideally,

some code library would provide a common set of system services you can take advantage of in your client/server application.

One library that simplifies the process of building distributed, scalable client/server applications is the Microsoft Transaction Server (MTS). It has been shipping in various forms since late 1996 and is freely available to all licensed users of Windows NT Server 4.0 and Windows NT Workstation 4.0. It is available from Microsoft's Web site at www.microsoft.com/transaction.

DISTRIBUTED COMPUTING

Why do we need distributed computing today? Because application requirements are outstripping the computing horsepower of even the most powerful single-node machines. Rather than replace your existing hardware with more exotic systems, you should be able to purchase more of

INSIDE

TUTOR: A further look at the quality of your monitor's image. This time we focus on resolution, synchronization, bandwidth, and the role of your video card. *Page 217.*

▼ POWER PROGRAMMING: Microsoft Transaction Server offers a rich runtime environment for scalable, distributed COM objects, but writing MTS apps requires a different approach to programming. We show you how to create a simple MTS app using Visual Basic 5.0. *Page 221.*



UTILITIES: Test your word-smithing abilities with this issue's utility PC Ladder. This program lets you create word-ladder games in which you can change one word to another, one letter at a time. *Page 227.*



PC SOLUTIONS: Which medium is best for long-term, reliable data backup; getting Microsoft Word to produce a slashed zero character; inserting spreadsheets into your current Excel workbook file; and much more. *Page 231.*



what you already have. For that to work, however, your application must be able to scale transparently to take advantage of your corporate network's additional computing power.

The main barrier to realizing such a vision is software. Today's operating systems and tools let us quickly build applications that connect to single-node servers. A distributed system, however, is by definition a collection of independent computers. We need a radically different set of system services that let us make such a collection appear to your client applications as a single computing node.

THREE-TIER CLIENT/SERVER

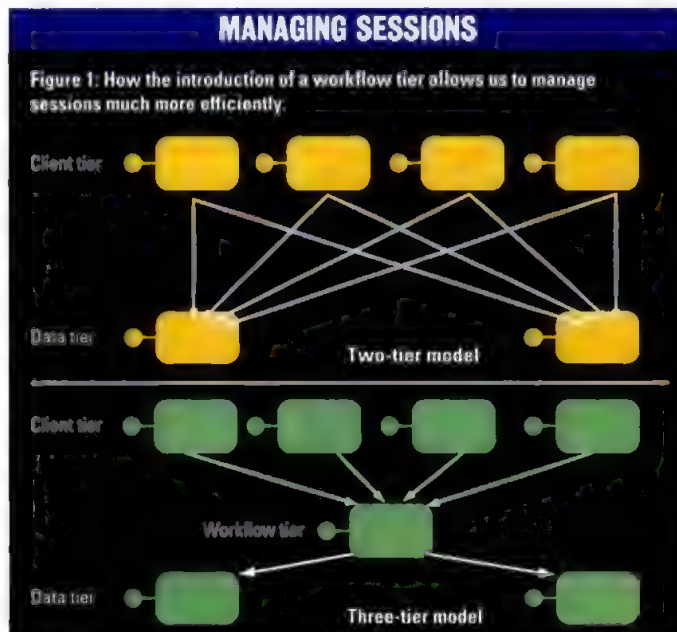
Numerous architectural issues become apparent in building systems whose computing load is distributed over a network of computing nodes. Probably the most important is the fact that the connections between computing nodes on a local area network are extremely slow relative to processor-memory connections. In most cases, it is *latency* or round-trip time—not network bandwidth—that becomes a major source of congestion within a distributed computing system.

A classic solution to the scalability problems posed by traditional two-tier client/server systems is the introduction of a third tier called the *workflow tier* (Figure 1). Client applications belong to the *presentation tier*, and the data they operate on belongs to the *data tier*.

The workflow tier of a three-tier client/server application is generally where you place your *business rules*, which enforce the integrity of the data your application uses. You can gain a number of important benefits here in improved scalability as the demands on your application increase. It is in the workflow tier that your components will execute within a runtime environment provided by MTS, and it is here that the challenges lie in building scalable distributed systems.

MTS SERVICES

In the following section, we'll take a tour of the services MTS provides for your distributed applications. As I introduce each service, I'll talk about the problem it solves, in order to give you some context. In general, you'll find that using MTS involves following a simple set of rules. Awareness of the problems that MTS solves, however, will give you valuable insight into how to design a distributed application.



SESSION MANAGEMENT

Maintaining each connection between client and server involves establishing some form of session between them. A session requires memory resources to store its state and processor resources to maintain and update its state. The real cost for maintaining a session is usually on the server side, as there are generally far more clients than there are servers. In a traditional two-tier scenario where m clients are connected to n servers, the total number of connections required is $m \times n$ (see the diagram shown in Figure 1). You can see that the overhead is quite steep: If you have 100,000 clients connecting to 100 servers, you would have to maintain 10,000,000 separate sessions to manage the communications!

One of the roles of the workflow tier is to manage the total number of sessions required by a distributed application. Taking our original example, let's introduce 10 new workflow controllers between clients and servers (Figure 1). Each workflow controller now manages 10 percent of the clients, so they each maintain 10,000 sessions with their clients. Each workflow controller must also manage connections to all of the servers, so they maintain 100 sessions to the servers. The total number of sessions works out to be $10 \times (10,000 + 100)$ or 101,000 sessions—a far cry from the 10,000,000 sessions of the original two-tier scenario. The number of sessions in a three-tier scenario is roughly $m + n$, as opposed to $m \times n$.

SERVER RESOURCE MANAGEMENT

Database connections are expensive resources, both in memory and in processor time. When the number of outstanding clients

grows beyond a certain threshold, a tremendous amount of server resources is required to maintain the large number of connections. Beyond this point, more processor time is used juggling active data sessions than handling incoming client requests.

As we saw earlier, the introduction of a workflow tier allows you to coordinate the activities of one or more database servers. More important, you can place logic within the workflow tier that allows for the efficient sharing of database connections in a scheme known as *connection pooling*.

MTS ships with a component called the ODBC resource dispenser, which automatically pools ODBC connections to ODBC-compliant databases. Pooling can yield significant performance

gains, since it eliminates the overhead of constructing and tearing down an ODBC connection each time you submit work to an ODBC database. Instead, the ODBC resource dispenser maintains a pool of preexisting ODBC connections and assigns incoming work to the next available connection, much as a bank assigns incoming customers to the next available teller.

DATA CONTENTION

In multiuser database applications, the single biggest barrier to scalability is contention for database records. Vendors have invested enormous amounts of time and money in optimizing their locking technologies. All of the burden need not lie with them, however; applications developers must also bear some of the responsibility for minimizing contention for database records in their applications.

The developer can control two elements: the number of database locks held by the application and the amount of time the application holds on to those locks. Redesigning the application code can minimize the number of locks held by the application. Placing the code that manipulates the data closer to the database can help minimize the amount of time that an application holds on to a database lock.

Traditional two-tier client/server applications made extensive use of SQL stored procedures to help developers minimize the amount of time that locks were held. Unfortunately, the language used to implement SQL stored procedures (Transact-SQL) is generally not as expressive as the mainstream object-

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oriented programming languages.

MTS objects can be written using virtually any object-oriented programming language and typically reside in the middle tier of a three-tier client/server system. When designed correctly, these middle-tier components let you centralize the application logic that accesses your databases. More important, by centralizing your data access in components that can take advantage of connection pooling and higher-speed connections to the database servers (particularly when the client applications connect over the Internet), the total time that database locks are held by these components is minimized. The amount of contention for data in the data tier is also minimized.

NETWORK ROUND TRIPS

Another factor that can limit the scalability of your application is the total number of network round trips required to do some work on your server. In today's object-oriented client/server applications, you will typically perform three atomic operations, each requiring at least one network round trip, to perform a given operation. These steps are creating an instance of an object on the server computer, invoking one or more methods on the object, and destroying the object on the server computer.

Since these are middle-tier objects, they are usually acquiring expensive resources to do their work. Typically these expensive resources are database connections and database locks. For your application to scale, it is essential that you conserve these resources. Therefore, client application programmers have traditionally created the objects just when they needed to use them and destroyed them immediately thereafter. The implication of this tactic is that we must pay the price of at least three network round trips to invoke a method on a server-side object.

By requiring three round trips to perform a single logical operation, we introduce an-

MTS reduces the number of round trips required to perform a single operation to almost one, through its use of a context wrapper object.



other potential bottleneck and thus limit the scalability of the application. Additional remote procedure call (RPC) runtime resources are required to handle the overhead of processing three distinct messages where only one does meaningful work. In theory, the operations required to create and destroy the object can be optimized out of existence.

MTS reduces the number of round trips required to perform a single operation to almost one. It optimizes the creation and destruction operations out of existence through its use of a *context wrapper* object. The context wrapper object, along with its associated context object (discussed below) forms an *object runtime environment* (Figure 2), which is conceptually the object that the client application sees; that there are three separate cooperating objects is an implementation detail.

For MTS to eliminate the need for a client application to create and destroy MTS objects, the client application must follow a complete-

times that you invoke methods on the object. The MTS network round-trip optimization is called *just-in-time activation*, and the key is the MTS context wrapper object, which implements the methods for the interfaces implemented by the actual object. It is created dynamically at runtime by MTS and is inserted transparently between the client application and the real MTS object. The context wrapper creates an instance of the MTS object at the moment it receives an incoming call from a client application—hence the term *just-in-time activation*.

For MTS to create a context wrapper object for any MTS object dynamically, it must know the intimate details of the object's interface signature. That requires that an MTS object meet a certain set of requirements. We'll discuss those requirements a little later when we examine what constitutes an MTS object.

Most distributed systems use the concept of a *transaction* to implement automatic recovery. Transactions allow a complex set of actions to appear as a single unit of work. Most modern transaction systems will pass the so-called "ACID" test, which consists of the following four key properties:

- **Atomic:** All of the work gets done or none of the work gets done.
- **Consistent:** The operation being performed is legal.
- **Isolated:** The behavior of a transaction is independent of the actions of any other transaction.
- **Durable:** Once a transaction has been completed, the work has been committed to durable storage.

TRANSACTIONS

Building a distributed application involves more than just scalability. As the complexity of the computing system increases, so does the probability of failure. Well-designed distributed applications are not only scalable but can also recover automatically from failure.

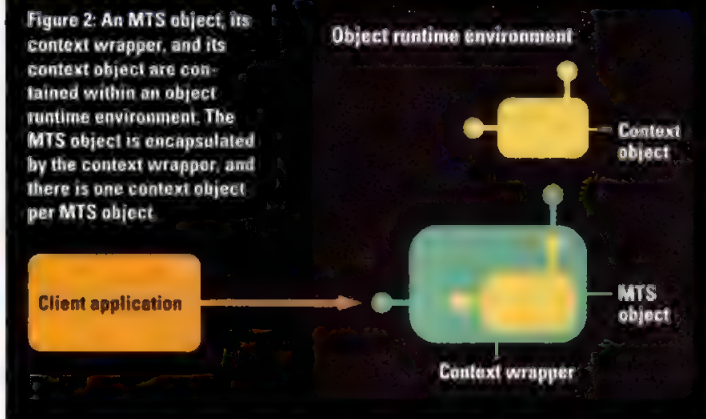
Most modern transaction systems will pass the so-called "ACID" test, which consists of the following four key properties:

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- **Isolated:** The behavior of a transaction is independent of the actions of any other transaction.
- **Durable:** Once a transaction has been completed, the work has been committed to durable storage.

A transaction forms a binding contract between a client application and the code running on the server. Once the server code has signaled a client that a transaction has succeeded, it has effectively guaranteed the client that the work has been committed to durable storage. Likewise, if the server code signals the client that the transaction has been aborted, the client code is promised that as far as the data is concerned, everything is as though the operation were never

WHAT THE CLIENT APPLICATION SEES

Figure 2: An MTS object, its context wrapper, and its context object are contained within an object runtime environment. The MTS object is encapsulated by the context wrapper, and there is one context object per MTS object.



ly different set of rules, acquiring a reference to the MTS object as early as possible and releasing it as late as possible. This lets MTS create an instance of the MTS object whenever an incoming call comes in. When the object signals to MTS that it has finished doing what it was doing, MTS destroys it but keeps the context wrapper alive to service the next incoming request (Figure 2). This effectively allows MTS to amortize an object's creation and destruction overhead across the total number of

attempted in the first place.

Transactions greatly simplify the code that you have to write to recover from error conditions. A transaction will either commit in its entirety or roll back in its entirety. Therefore, your error-recovery code does not have to contend with undoing partially completed work.

To leverage further the benefits of transactions, it is generally a good idea to partition a large transaction into one or more nested transactions. A single transaction can actually be composed of several nested transactions that branch out from a root transaction. Should a nested transaction fail, you can attempt to handle the error locally, or you can choose to abort the entire transaction. In this manner, transactions are similar to the exception-based programming model that is available to programmers in languages such as C++, Object Pascal, and Visual Basic, which have the ability to handle an error condition where it is most appropriate and take advantage of default behavior in all other cases.

SCALING THE DATA TIER

For transactions to be useful in a distributed computing environment, we must also consider what happens when the data tier becomes the bottleneck in our distributed application. Once again, we would like to be able to make incremental purchases of hardware and software to increase the throughput of our distributed application. Ideally, these hardware and software packages can be assembled from commodity components at commodity prices. And since components generally become commodity components because of extensive competition, we must have a common infrastructure for assembling them.

To scale the data tier, we must be able to enlist more than one database server into an MTS transaction. That would let us partition a logical database into one or more physical database server nodes. To facilitate this, MTS uses Microsoft's Distributed Transaction Coordinator (DTC) to allow transactions to span more than one database server. DTC uses existing industry standards (the X/Open XA protocol and IBM's LU6.2 protocol) and Microsoft's own OLE Transactions protocol to allow transactions to span not just multiple database servers but also to span servers running different database server software.

SECURITY

Security is difficult. Programmers who have implemented server-side security have had to deal with a plethora of Windows NT data structures and API functions. To eliminate much of the minutiae that has been associated with security programming, MTS introduces the concept of *role-based security*. To use role-based security, you must group your MTS components into *packages* and assign *roles* to those packages during development. For example, you could create Manager and Data Entry Clerk roles. At deployment time, a

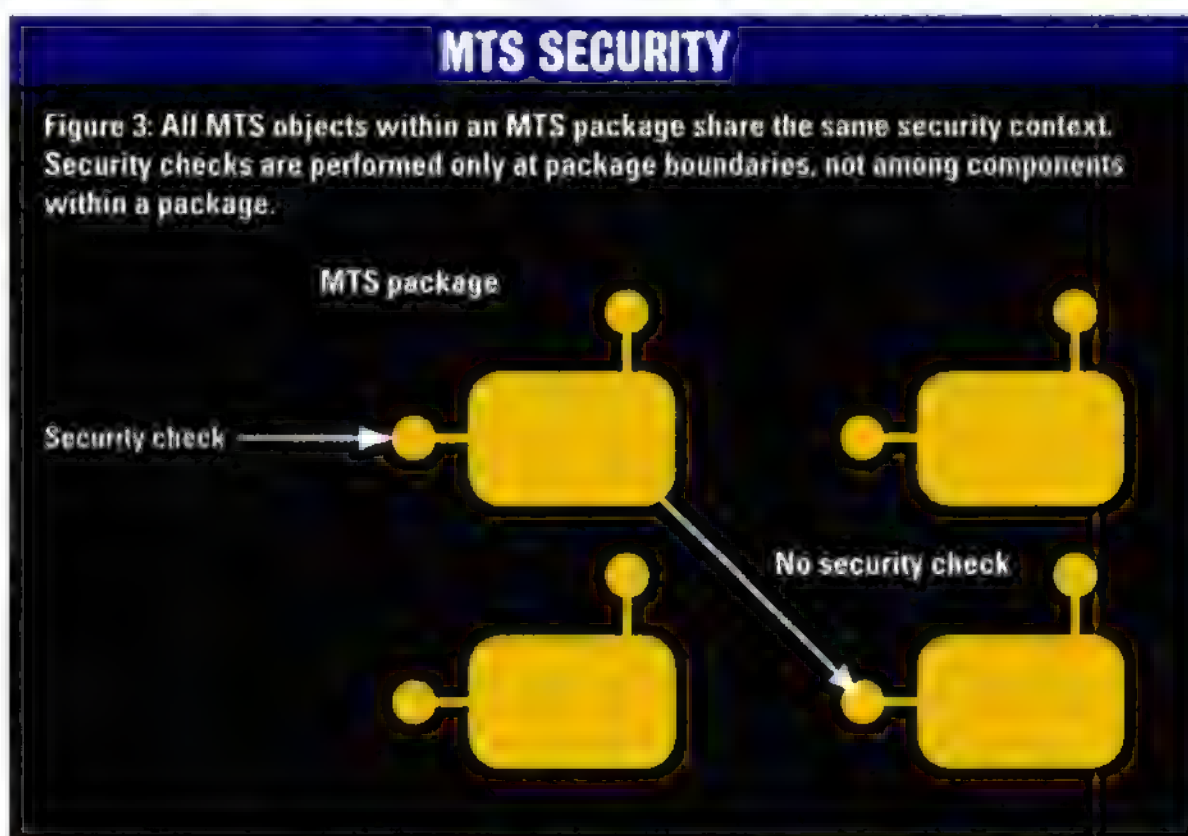
is free to call any other components in the same package without the overhead of another security check (Figure 3). If you want to call components in another package, however, you have to clear another security check at that point.

MTS PROGRAMMING MODEL

MTS was designed to leverage the component infrastructure COM provides today. You can think of MTS as providing a runtime infrastructure for COM objects. A COM object, however, must meet several requirements to

qualify as an MTS object and thus to qualify for automatic MTS runtime support.

An MTS object must be housed in a 32-bit dynamic link library. The DLL must also meet the general requirements for a DLL-based COM server. That is, it must be a self-registering DLL that exports the `DllRegisterServer` and `DllUnregisterServer` functions, and it must implement the well-known entry points `DllGetClassObject` and `DllCanUnloadNow`. Additionally, the MTS object must be created via a standard class factory object that implements



Windows NT administrator assigns actual users to the roles you defined during development. At runtime, users who have been assigned to particular roles will be allowed or denied access to different pieces of functionality within your MTS package.

Role-based security lets MTS make *automatic* security checks on your behalf. When a client application attempts to make a call into an MTS object, MTS performs a security check on the client. The security check is concerned with *authentication* and *access control*. Authentication involves ensuring that the user is who he claims to be. MTS leverages the existing Windows NT security infrastructure to perform the authentication. Access control is concerned with whether a user is permitted to perform the operation he is requesting. MTS checks whether a user has been assigned to a particular role to determine whether or not the request will succeed.

You can secure access to individual interfaces and components using the MTS explorer. The automatic security check is performed first against roles assigned at the interface level and then against roles assigned at the component level. Once a client application has successfully cleared the security check, it

the `IClassFactory` interface. Most common development tools, such as Delphi 3.0, Visual Basic 5.0, and Visual C++ 5.0, can create dynamic link libraries that fit these requirements.

MTS needs to know the function names and parameter types for all interfaces implemented by an MTS object, so there are some restrictions with respect to the properties of the interfaces that are implemented by an MTS object. The interface definition information must be provided in some kind of machine-readable form, so that MTS can dynamically create the context wrapper object. An MTS object's interfaces must be either Automation-compatible, in which case the MTS object's type library provides the interface definition, or they must be standard-marshaled interfaces that use the fully interpreted marshaler, in which case the proxy/stub DLL provides the interface definition.

THE CONTEXT WRAPPER

The context wrapper object is what external clients see as the actual MTS object (Figure 2). When a client application acquires a reference to an MTS object, it is actually holding onto a reference to a context wrapper object dynamically created by the MTS runtime. It is the context wrapper object that implements

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just-in-time activation and performs the automatic security checks.

When a client application calls a method on an MTS object, MTS does a number of things automatically. First, it performs the security check described earlier. If the client application passes the security check (that is, both identity and role are confirmed), the context wrapper object checks whether it is holding on to a reference to an instance of the object. For most MTS objects, the context wrapper object must create a new instance of the object and then call the actual method on that object. When the method returns control to the context wrapper object, it checks to see whether the method called `SetAbort` or `Set-`

```
' Do error handling
context.SetAbort
Exit Sub
```

You will also use some of the other methods in the context object to implement programmatic security and to enlist additional MTS objects in your transaction. You will call the function `IsCallerInRole` to see if the caller's access token matches one of the roles assigned using the MTS Explorer. The member function `CreateInstance` allows you to create an instance of another MTS object and enlist it within the scope of the current transaction.

For further information about the details of the MTS programming model, please see the accompanying Power Programming column in this issue.

SUMMARIZING

COM and MTS today give you the plumbing for your distributed applications. COM provides the founda-

The services MTS supplies help to eliminate much of the redundant code otherwise needed to build distributed applications.



Complete. If so, the context wrapper destroys the object before returning control to the client application.

THE CONTEXT OBJECT

Every instance of an MTS object also has a unique context object associated with it. You can use the MTS API function `GetObjectContext` to retrieve a reference to an MTS object's context object. The context object is a COM object that implements the `IObjectContext` interface.

As an MTS programmer, you will commonly invoke the `SetAbort` and `SetComplete` methods of the `IObjectContext` interface. This allows you to tell MTS that you have completed doing work with your object and that your object can be destroyed when you exit from the function. Typically, you will use the context object, as illustrated by the following Visual Basic code:

```
Dim context as ObjectContext
Set context = GetObjectContext()
```

```
On Error Goto Handle_Error
' Do work
context.SetComplete()
Exit Sub
```

```
Handle_Error:
```

tion upon which all of the MTS services are built. The services MTS supplies help to eliminate much of the redundant code required to build distributed applications. Together COM and MTS reduce the amount of work involved in creating distributed applications and also provide a clean migration path to tomorrow's infrastructure for building distributed applications: COM+.

FURTHER READING

For a fine introduction to the problems of building distributed applications, see *Principles of Transaction Processing*, by Philip Bernstein and Eric Newcomer (Morgan Kaufmann, 1997).

For an excellent source of information on transaction processing—particularly as it relates to Microsoft technology—see Jim Gray's page at Microsoft Research (<http://research.microsoft.com/research/barc/Gray>).

For details on implementing your own MTS object using Visual Basic 5.0, see the Power Programming column "Writing a Microsoft Transaction Server App," in this issue. **PC**

John Lam, the curator of the IUnknown.com Web site, writes and teaches about COM, IIS, and MTS. He also delivers training courses for DevelopMentor (www.develop.com). He can be contacted at www.IUnknown.com.

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What Constitutes a Fine Resolution?

A further look at factors that can affect the image quality of your monitor.

By Neil Randall

Last time around, we looked at some of the causes of fuzziness and distortion on your monitor. But there are other factors that affect the quality of your display. This time, we'll look at display resolution, synchronization, and bandwidth and at the role of the graphics adapter (video card).

Let's begin with a quick recap of our earlier column. The back of the display face of a monitor is coated with red, green, and blue phosphors, arranged in three-dot or three-stripe patterns called pixels. Three electron guns—guided to the correct-color dot by a shadow mask or aperture grille—fire beams at the display face, causing the phosphors to glow. The beams sweep horizontally across the monitor (starting at the top and working their way down), painting the screen and thereby creating an image.

TOWARD RESOLUTION

The most common term used to refer to display quality is *resolution*. And indeed, resolution is an important consideration. But by itself it doesn't improve or hinder your monitor's display quality. Factors such as bandwidth and refresh rate also figure in. Let's look at how these factors work together.

Resolution has two distinct meanings in the computer-display industry. First, it can refer to the monitor's ability to display fine detail, in which case the resolution is typically expressed in *dots per inch* (dpi). But it can also refer to the limits of the image, and in this sense resolution is stated as a combination of two numbers. The de facto standards in display resolution within a Microsoft Windows graphical environment are 640-by-480, 800-by-600, 1,024-by-768, 1,280-by-1,024, and 1,600-by-1,200. The first number refers to the number of individual pixels the monitor can display horizontally, while the second is the number of pixels it can display vertically. In other words,

the dpi figure represents the capabilities of the monitor alone, while the other shows the capabilities of the monitor and the video card together. Here, we will use the second and more common use of *resolution*.

One variable that affects resolution is the size of the screen itself. Standard monitor sizes are 14-inch, 15-inch, 17-inch, and 21-inch. Recently, 19-inch monitors have appeared as well. This measurement reflects the number of inches that stretch diagonally across the front of the cathode-ray tube (CRT), or picture tube. The viewable display area of your monitor is a little less than the manufacturer's stated size, because of the plastic molding around the screen. As the image moves toward the edges of the display, sharpness decreases, and as a result, the maximum size for effective display differs from the tube size itself. Manufacturers often list both measurements, and in fact Version 1.1 of the VESA Video Image Area Definition standard (www.vesa.org/dload/summary/summary.pdf.html) specifies that the image area must be stated as the "largest rectangle image

(any combination of VGA card and monitor can achieve this resolution), screen elements (icons, text, and so on) will appear in a readable size. You might be able to squeeze 1,024-by-768 out of your 14-inch monitor (again, as long as the video card can offer 1,024-by-768, and most can), but a 15-inch monitor with corresponding video card provides that same resolution with the dots spread out more, the result being a more readable image. For a useful 1,280-by-1,024 image, you need at least a 17-inch monitor, but even here the pixels may be too small for screen elements to be viewed comfortably. Figure 1 lists the recommended resolutions for the various display sizes.

BANDWIDTH AND DOT CLOCK

Other technologies that impact the quality of monitor resolution include *bandwidth*, *dot clock*, *refresh rate*, *horizontal scan rate*, and the video card's video chip set and memory. Even the cable that connects the monitor to the video port can make a difference, to the degree that it's usually inadvisable to use a video extension cable for this connection.

Bandwidth is a measure of the total amount of data the display can accommodate every second (measured in megabytes per second). A natural conclusion would be that greater bandwidth means sharper displays, but in fact the dot pitch of the tube (the distance between two phosphors of the same color) is of greater significance. Bandwidth and dot pitch do coincide in one important area: the relationship between display bandwidth and the video

controller's dot clock, the maximum rate of data transfer sustainable by the video controller. The idea is to match the dot clock of the video controller and the bandwidth of the display. The higher the dot clock, the higher the possible resolutions and re-

fresh rates. As a rule of thumb, the bandwidth measurement should be about 25 percent higher than the dot-clock measurement.

REFRESH AND SCAN FREQUENCIES

Each video standard, from the ancient CGA up through Super VGA and into the new higher-resolution standards, requires a minimum horizontal and vertical scanning rate (or number of times per second that the screen is redrawn), along with a monitor capable of synchronizing to this rate. The horizontal rate goes by several names—including *horizontal*

RESOLUTIONS BY DISPLAY SIZE

	BEST—optimally readable		GOOD—acceptably readable		MARGINAL—difficult to read; pixels too small or too large	
	BAD—extremely difficult to read; pixels too small or too large		WORST—unreadable			
Display size	640-by-480	800-by-600	1,024-by-768	1,280-by-1,024	1,600-by-1,200	
14 inches	BEST	GOOD	MARGINAL	WORST	WORST	
15 inches	GOOD	GOOD	BEST	BAD	WORST	
17 inches	MARGINAL	GOOD	BEST	MARGINAL	BAD	
19 inches	MARGINAL	MARGINAL	GOOD	BEST	MARGINAL	
21 inches	BAD	MARGINAL	GOOD	BEST	GOOD	

FIGURE 1: This table will help you find the best resolution for your display size.

that the display is capable of displaying as a viewed image."

Screen size and effective resolution are directly linked: A 15-inch monitor with 800 by 600 pixels will have a higher resolution than a 19-inch monitor with the same number of pixels. Therefore, in order to maintain the same resolution, a larger monitor must contain smaller pixels. A by-product of this relationship is that if you set a small monitor to a high resolution, you may not be able to read what's on your screen. For example, if you select 640 by 480 pixels on a 14-inch monitor

synchronizing frequency and line rate—but we'll use *horizontal scan rate* (HSR). The vertical rate also has several names, including *vertical scan rate* and *frame rate*, but we'll use the conventional term *refresh rate*.

The horizontal scan rate is the speed at which the electron gun can draw lines of pixels on the display face and thus create the desired image. The rate, in kilohertz (kHz), measures the number of lines the gun can draw in one second, or, more precisely, how many times per second it can move from left to right across the screen and go to the beginning of the next line. The actual rate is controlled not by the monitor but by the video controller (often on a video card), but the monitor must be capable of displaying data at that speed or else it will produce a poor display. The higher the resolution you want, the higher the horizontal scan rate must be, in order for the electron guns to paint the entire screen within the time specified by the refresh rate. The minimum HSR for VGA graphics is 31.5 kHz, while the 1,024-by-768 VESA standard requires a 60-kHz horizontal scan rate. See Figure 2 for a listing of requirements for other video standards.

The video controller also controls the vertical synchronization, and once again the monitor must be able to handle the speed at which the card sends data. *Vertical synchronization* refers to the ability of the video card and the monitor to update the entire display, or *refresh* the screen. The refresh rate, expressed in hertz (Hz), is the maximum number of times per second that the screen can be updated. When the electron gun reaches the bottom-right corner of the display, the video controller sends it back to the top left to begin producing the next full display, or "frame." For the gun to paint a display of sufficient detail and color to satisfy the human eye, this must occur many times per second, ideally as high as 72 (a 72-Hz refresh rate) or more. The higher the desired resolution, the higher the necessary refresh rate, in order to prevent display flicker (and the resulting eyestrain).

The anomaly here, of course, is IBM's original XGA standard. It requires only a 44-Hz refresh rate, because it calls for the display to be interlaced, meaning only half the display is drawn in each pass.

THE VIDEO CARD

Most systems today ship with the video controller as a separate peripheral board, known as a video card. Even on systems with a video

controller built onto the motherboard, the setup program allows you to disable the on-board video so that you can install a separate card. The reason for this is that video controllers are not created equal, and you may very well want to try a different video system.

The video card acts as a go-between. The card takes information from the CPU and passes it on to the monitor. The CPU receives instructions from the application (word processor, graphics program, Web browser) that specific data is to be sent to the video card

to do with how much of this step need not be handled by the CPU. Video accelerators contain circuitry that allows them to take some of the load off the CPU, and higher-end video cards contain even more powerful circuitry for this task. Naturally, given that we're dealing with computer data here, the video chip puts the data in video memory into a digital format. That's fine except for the fact that a CRT is analog, not digital; the video card contains a digital-to-analog converter (DAC) to take care of the problem. The DAC sends the signal out to the electron guns, which shoot their beams at the phosphors and create the display that you see.

Aside from speed, how do video boards affect your screen display? First, like the monitor, the video board supports a specific range of resolutions and color depths. The video chip itself determines the possible color depths, but the actual combinations of color depth and screen resolution are determined by the amount of memory on the card itself. A low-end VGA board with 256K of video memory (if you can

still find one) is capable of displaying a 640-by-480 resolution with only 16 colors, while a much higher-end 8-megabyte accelerator can offer 1,280-by-1,024 resolution with millions of colors. Obviously, the more video memory, the more display choices open to you, as long as your monitor is capable of handling them. Secondly, your video board is capable of specific horizontal scan rates and vertical refresh rates, just as your monitor is. Given that the best display is usually obtained through the highest scan and refresh rates, especially the latter, it makes sense to buy a board that will provide high refresh rates at high resolutions. That 1,280-by-1,024 resolution with 32-bit true color, after all, isn't much good if you have to choose a refresh rate that allows only interlacing and hence produces flicker.

Ideally, you should buy the largest monitor you can afford, one capable of high scan rates, refresh rates, and resolutions and also capable of the smallest dot pitches possible (anything larger than 0.28 dpi is usually unacceptable). Of course, a large, high-resolution monitor will be pricey. But it's better to skimp on the video card, because it's much less expensive to upgrade that at a later point than it would be to upgrade the monitor. In short, get the best monitor you can afford, because—let's face it—your eyes are at stake. **PC**

Neil Randall is a frequent contributor to PC Magazine.

SCAN RATES FOR DISPLAY STANDARDS

Video standard	Resolution	Horizontal scan rate (kHz)	Vertical refresh rate (Hz)
CGA	640-by-200	15.75	60
EGA	640-by-350	21.5	60
VGA	640-by-480	31.5	60
VESA 640	640-by-480	37.5	75
SVGA	800-by-600	37.5	60
VESA 800	800-by-600	48	72
XGA	1,024-by-768	56.6	44
Standard 1024	1,024-by-768	48.3	60
VESA 1024	1,024-by-768	60	75
VESA 1280	1,280-by-1,024	80	75

FIGURE 2: The required scan rates vary for the different video standards.

for display processing. This means that at the very least, video speed and CPU speed correspond: the faster the CPU, the faster the video. But the speed of transfer also depends on the speed of the system bus. The de facto standard is the PCI bus, and while it's faster than the ISA bus by a good measure, it's still capable of slowing down video speed. But there's not much you can do about that, and graphics accelerators have been dealing with that issue since the ISA-only days.

Once through the system bus, the display instruction (the image) is stored in video memory, where the video card's video chip locates it and works with it. Ideally, the video memory can handle input from the CPU and output to the video chip at the same time, but with conventional RAM this isn't possible—hence the development of dual-ported RAM, or VRAM (video RAM). As its name suggests, dual-ported offers two ports, thus allowing the CPU and the video chip set to access a memory address at the same time. VRAM improves speed, and the more VRAM the better, since more image data can be stored and manipulated. Even better is Windows RAM (WRAM), which allows for the easy addressing of large blocks of video memory, saving the CPU several processing steps.

The function of the video chip is to convert the data in video memory into a displayable format. This is a major factor in display speed, and much of what you'll pay for on a video card has

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Writing a Microsoft Transaction Server App

Programming an MTS page-counter component for IIS using Visual Basic 5.0.

By John Lam

Microsoft Transaction Server (MTS) is a great infrastructure for building scalable, distributed applications. It provides a rich runtime environment for COM objects that enables them to scale automatically as the demands on your application increase. However, to take full advantage of the runtime services provided by MTS, you will have to change the way you write applications.

This article will walk you through the creation of a simple MTS application using Visual Basic 5.0. We'll create a page-counter component that can be used by an Internet Information Server (IIS) 3.0 application to display a count of the total number of visitors to your Web site. The component will demonstrate most of the interesting features of an MTS application: just-in-time activation, the Shared Property Manager, connection pooling, and transactions. You can download the component and its source code from PC Magazine Online (www.pcmag.com).

AN OVERVIEW OF THE PROBLEM

Whenever a new visitor connects to our IIS Web site, we want to increment the count of the total number of visitors who have visited our site. We'll use Visual Basic to create a Visual Basic MTS component that leverages IIS's ability to track all of the active users on our Web site.

To track all of the active users on a Web site, IIS must be able to identify each user uniquely. However, this is not as simple as it seems, because the HyperText Transfer Protocol (HTTP) is a *connectionless* protocol. Unless special measures are taken, an HTTP server cannot tell whether a particular transaction represents a new user arriving on the site or an already present user simply moving to a different page.

IIS uses a *cookie* to identify a user each time he connects. The first time that a user connects to IIS, it sends a cookie to that user's Web browser. Each subsequent time a user reconnects to IIS during his current session, IIS can identify that user by inspecting his browser's cookie collection. If a user hasn't recon-

nected within a predetermined period of time (the default is 20 minutes), IIS assumes that the user has terminated his session and invalidates that user's cookie.

In cases where the user has instructed his Web browser to reject cookies, IIS can no longer uniquely identify this user. While this does not prevent the user from accessing the site, the site may not behave correctly. The extent to which the site misbehaves depends on how much the Web site developer depends on the user data

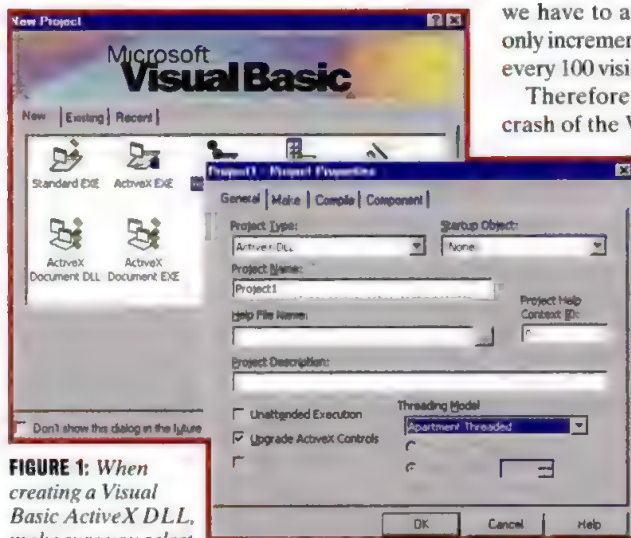


FIGURE 1: When creating a Visual Basic ActiveX DLL, make sure you select the Apartment Threading model, for maximum performance.

stored in the session object. In the case of our page-counter application, the counter will be increment-

ed every time the user requests the page that contains the page-counter component.

When a user initiates a new session with our Web site, IIS creates a session object that represents that user for the duration of his stay. It fires the *Session_OnStart* event immediately after it has created the user's session object. We can handle this event by writing code that increments our visitor count in a special Active Server Pages (ASP) file.

SCALABILITY VS. SAFETY

Where do we store a count of the total number of visitors to our site? We would like to store it persistently, so that it can survive any

crashes of our Web server. You could imagine storing the counter value in a file or in a database table. However, it takes a significant number of machine instructions to manipulate data in a file or to manipulate data stored in a database table. As the total number of visitors to your Web site increases, so too does the load on the page-counter component. This could have a negative impact on the scalability of your Web application.

To improve the scalability of the counter application, we must minimize the number of machine instructions it executes when incrementing the visitor counter. Since accessing RAM is fast and requires few machine instructions, let's use RAM to store our visitor count.

To ensure that the application is safe, we must also store the visitor count persistently; in our case we'll store it in a database table. However, to minimize the number of times we have to access the database table, we'll only increment the value in the database table every 100 visitors.

Therefore, in a worst-case scenario, a crash of the Web server would result in the page-counter value being off by a maximum value of 100. Considering that server crashes are relatively rare events and that the total number of visitors to a heavily trafficked site is high, this *may* be an acceptable number for you. In your own applications, however, you must ultimately make the decision, choosing between safety and scalability.

VB 5.0 COM OBJECTS

Visual Basic 5.0 lets you build COM components rapidly. Since an MTS object must be housed in a DLL-based COM server, we'll create an ActiveX DLL project in VB 5 (Figure 1). To take maximum advantage of the threading support in MTS, you must download Service Pack 3 of VB 5 from www.microsoft.com/vbasic, which allows you to create apartment-threaded COM objects. To enable this feature, make sure that you have selected the Apartment Threading model in the Project Properties dialog of your ActiveX DLL project.

When you are creating class modules in Visual Basic, you are really creating COM objects. To implement our page-counter component, we will be creating a number of class modules, each of which represents an integral part of our page-counter application.

PCTech Power Programming

THE PAGE-COUNTER APPLICATION

The page-counter application consists of a set of three Visual Basic class modules, each of which corresponds to a single MTS object. The CreateTable component is responsible for creating the SQL Server 6.5 table used to store the actual page count. The UpdatePageCount component is used to update the persistent page counter, and finally, the PageCount component manages the volatile page count stored in RAM.

These three components allow me to show you various features of MTS. The CreateTable and UpdatePageCount components demonstrate how you can leverage transactions and ODBC connection pooling. The PageCount component demonstrates the use of the Shared Property Manager to share state among multiple instances of the PageCount component.

Of the three, it is the PageCount component that is directly visible to the outside world. It manipulates the nondurable visitor count by using the Shared Property Manager. When necessary, it uses the CreateTable and UpdatePageCount components to manipulate the durable visitor count. Before examining these components, let's look at the way in which MTS distinguishes between durable and nondurable data.

DURABLE VS. NONDURABLE

MTS provides developers with a choice: whether to maintain data (called "state" in this context) in durable or nondurable storage. As I discussed above, the decision to use durable or nondurable storage is largely a choice between safety and scalability. While maintaining your state in durable storage results in greater safety, many more machine instructions must be executed to manipulate that state, thereby limiting scalability.

The Shared Property Manager is used to share nondurable state across multiple MTS objects. Since it maintains this state in RAM, using the Shared Property Manager results in greater scalability. It also ensures that all access to its internal state is serialized, thereby preventing multiple threads from potentially corrupting the internal state it's responsible for. However, the drawback is that the state it maintains cannot survive a machine failure.

To allow state to survive machine failures, we use the SQL Server Resource Manager to manage durable state. State that is managed by the Resource Manager, and manipulated within the context of an MTS transaction, is *guaranteed* to be committed to durable storage as soon as the MTS transaction has signaled that the transaction is *complete*. This allows you to simplify your application logic,

with the assurance that your data will be safely stored in persistent storage when the Resource Manager says your transaction has been completed.

THE PAGE COUNTER IN ACTION

The page-counter component is created at session-level scope by the following HTML in the Global.asa file:

```
<OBJECT
  PROGID="ViperCounter.PageCount"
  RUNAT=Server
  SCOPE=Session
  ID=VC>
</OBJECT>
```

(Viper was the code name for Microsoft Transaction Server. Developers often use it as shorthand.)

Session-level scope means that there is an instance of the PageCount component for every active session in IIS. We use the OBJECT tag's ID parameter to identify the PageCount component using the identifier VC. This identifier is visible at session-level scope from any page within our ASP application.

The Global.asa file allows you to create objects and write code that must appear at application or session-level scope within your ASP application. To increment our page count, we add the following event-handling code to our Global.asa file:

```
Sub Session_OnStart
  ' Other code omitted for clarity
  Session( "PageCount" ) =
    VC.GetPageCount()
End Sub
```

On the right-hand side of the assignment, we are calling the GetPageCount method of our page-counter component. The GetPageCount method will increment the visitor count and return the updated value. On the left-hand side of the assignment, we are storing this value in a named property (PageCount) of our user's Session object, to make that value available to any of the ASP code in our application.

Let's now turn our attention to the Visual Basic code for our PageCount component. The PageCount component has a single method: GetPageCount. We can see that the GetPageCount method follows the standard pattern for MTS component code:

```
Dim context as ObjectContext
Set context = GetObjectContext()

On Error Goto Handle_Error
```

```
' Do work
context.SetComplete()
Exit Sub
```

```
Handle_Error:
' Do error handling
context.SetAbort
Exit Sub
```

As discussed in the PC Tech feature in this issue, "Building Scalable Apps," the SetComplete and SetAbort calls on the context object allow MTS to implement just-in-time activation by allowing the context object to destroy your MTS object when the method call returns.

Since our PageCount component manipulates data stored in the Shared Property Manager, we first create a reference to the Shared Property Manager component:

```
Dim spmMgr As
SharedProperty GroupManager
Set spmMgr = CreateObject
("MTXSpm.SharedPropertyGroup
Manager.1")
```

The "MTXSpm.SharedPropertyGroupManager.1" parameter is the Programmatic Identifier (PROGID) that identifies the Shared Property Manager component on the server computer.

Our code manipulates two properties called Next and MaxNum, which are created within a property group called Counter. The following code retrieves a reference to the Counter shared-property group and retrieves additional references to the Next and MaxNum shared properties:

```
Dim spmGroup As SharedPropertyGroup
Set spmGroup = spmMgr.Create-
PropertyGroup("Counter",
LockSetGet, Process, bResult)
```

```
Dim spmPropNextCount As
SharedProperty
Set spmPropNextCount =
spmGroup.CreateProperty("Next",
bResult)
```

```
Dim spmPropMaxNum As
SharedProperty
Set spmPropMaxNum =
spmGroup.CreateProperty("MaxNum",
bResult)
```

When the GetPageCount method is called, we increment the Next count stored in the Shared Property Manager component and return the value to the user:

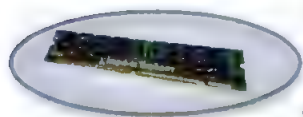
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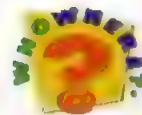
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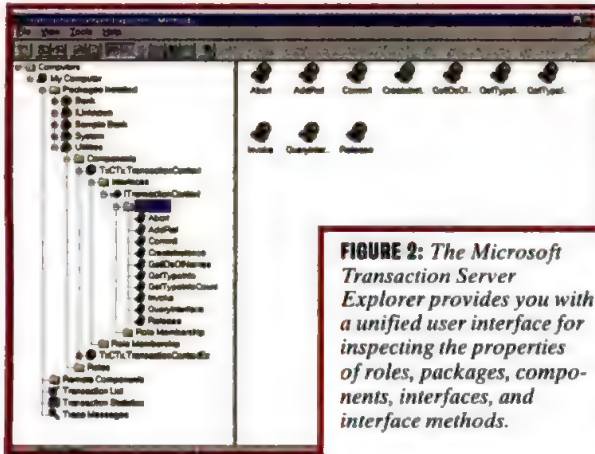


FIGURE 2: The Microsoft Transaction Server Explorer provides you with a unified user interface for inspecting the properties of roles, packages, components, interfaces, and interface methods.

```
spmPropNextCount.Value =  
spmPropNextCount.Value + 1
```

```
context.SetComplete  
GetPageCount = spmProp-  
NextCount.Value  
Exit Function
```

In 1 out of 100 calls to the `GetPageCount` method, we will also have to manipulate the durable count stored within the SQL Server Resource Manager component. This requires us to use the `UpdatePageCount` component, which we will enlist into our transaction by creating a new instance of it using our `Context` object.

By calling the `Update` method of the `UpdatePageCount` component, we will ensure that the durable visitor counter has been updated. We then update the `MaxNum` property in the Shared Property Manager by adding 100 to its current value to reflect the new, updated value in the database table:

```
If spmPropNextCount.Value >=  
spmPropMaxNum.Value Then  
    Set objCounterUpdate =  
        context.CreateInstance  
        ("ViperCounter.UpdatePageCount")  
    spmPropNextCount.Value =  
        objCounterUpdate.Update  
        (strResult)  
    spmPropMaxNum.Value =  
        spmPropNextCount.Value + 100  
End If
```

The `Update` method of the `UpdatePageCount` component manipulates the durable count stored using the SQL Server Resource Manager. The `Update` method performs two functions:

- creating the SQL Server tables if this is the first time that the `Update` method has been called;

- updating the page-count value in the SQL Server table.

If the `Update` method has to create the database table that stores the durable visitor count, it enlists the help of the `CreateTable` component. The `CreateTable` component creates the table within the context of an MTS transaction to simplify writing the error-recovery code. For details of this component's implementation, please consult the accompanying source code.

The `Update` method of the `UpdatePageCount` component illustrates a number of interesting MTS programming concepts. While it follows the standard MTS transaction pattern for a method, it also illustrates some interesting ways of leveraging Visual Basic's exception-handling capabilities to simplify error recovery.

If an error occurs during our attempt to update the table, we presume that the error implies that we need to create the table in the first place, so any error will cause execution to branch to the `ErrorCreateTable` error handler:

```
ErrorCreateTable:  
    On Error GoTo ErrorHandler  
  
    ' create the receipt table  
    Dim objCreateTable As CreateTable  
    Set objCreateTable =  
        CreateObject("ViperCounter.  
        CreateTable")  
    objCreateTable.CreateReceipt  
    GoTo TryAgain
```

If any errors occur here while we are trying to create a new table using our `CreateTable` component, we branch to our generic `ErrorHandler` code.

The rest of the code in the `Update` method simply increments the durable visitor counter by 100. This is an arbitrary value that works well for this example. Feel free to change this value in this location and in the `Update` method, if you wish to sacrifice additional safety (by increasing this value) in favor of additional performance.

Since the durable visitor counter is stored in the `Counter` table in our SQL Server database, it must communicate with the SQL Server Resource Manager by way of ADO (ActiveX Data Objects) connections. The following code sets up the ADO connections to the SQL Server database and initializes

our command and record-set ADO objects. Since this code executes within the MTS run-time environment, the ADO connection is retrieved from a pool of ADO connections managed by MTS:

```
Dim adoConn As New  
ADODB.Connection  
adoConn.ConnectionTimeout = 15  
adoConn.CommandTimeout = 30  
adoConn.Open strConnect,  
"userid", "password"  
  
' set up ADO command object  
Dim adoCommand As New  
ADODB.Command  
adoCommand.CommandText = "SELECT  
* FROM Counter"  
adoCommand.CommandType =  
adCmdText  
Set adoCommand.ActiveConnection =  
adoConn  
  
' set up ADO recordset  
Dim lngNextReceipt As Long  
Dim adoRecordSet As New  
ADODB.Recordset
```

As mentioned above, if an error is encountered during the execution of this code, execution will transfer to the `ErrorCreateTable` error handler. Otherwise, we continue executing the main block of code and open the main record set:

```
TryAgain:  
    adoRecordSet.Open adoCommand,  
    adOpenKeyset, adLockOptimistic
```

We reset the error handler code to ensure that any errors encountered within this section will branch not to the `ErrorCreateTable` handler but instead to the generic `ErrorHandler` code:

```
On Error GoTo ErrorHandler
```

If all goes well, we retrieve the persistent counter value stored in the `NextCount` field of the `Count` table:

```
lngNextReceipt = adoRecordSet-  
("NextCount")  
adoRecordSet.Close
```

We will use this value to perform an update query within the context of our transaction. The update query will ensure that the visitor-counter value in the database will be incremented correctly (by an additional 100 users). Upon exiting the `Update` method, we return

PCTech Power Programming

the current visitor count to the caller.

```
Dim adoCommand2 As New
ADODB.Command
adoCommand2.CommandText =
"UPDATE Counter SET NextCount =
" & (lngNextReceipt + 100)
adoCommand2.CommandType =
adCmdText
Set adoCommand2.ActiveConnection
= adoConn
adoCommand2.Execute

adoConn.Close
ctxObject.SetComplete
Update = lngNextReceipt
```

Exit Function

REGISTERING YOUR COMPONENT

Before you can use your MTS components in the MTS environment, you must build and register those components as an ActiveX DLL. Simply building your components in the VB IDE will automatically register your components as COM components. That is, all of the Registry entries that identify your VB class modules as COM components will be automatically created for you. However, for

your COM objects to become full-fledged MTS components, you must also register them with the MTS runtime environment.

Fortunately, registering your components with the MTS environment is no more difficult than running the MTS Explorer. The MTS Explorer (Figure 2) provides you with an easy-to-use graphical user interface in which you can browse your registered MTS components or change the attributes of those components.

Your MTS components will be grouped into logical entities known as *packages*. A package defines a security boundary for your MTS components. All MTS components that live inside a particular package will share the same security boundary.

In our case, I have created a package called IUnknown, and within it I have registered the PageCount, CreateTable, and UpdatePageCount components. This package must be installed on the same computer that is running IIS. While a detailed discussion of security is beyond the scope of this article, you will typically use the MTS Explorer to define roles for your package and assign roles to individual components or individual interfaces on those components. This information is used by MTS to perform automatic security checks at runtime.

NEXT STEPS

You should download the source code that accompanies this article. Feel free to change this code to suit your particular application. Keep in mind, however, that you must have access to a machine running Windows NT Server 4.0, IIS 3.0, and Microsoft Transaction Server 1.1 in order to try out the component.

Because of the extremely rapid pace of development of these technologies, most of the interesting information on creating MTS components and ASP components can be found online. Check out www.microsoft.com/iis for the latest information on building ASP components. If you have access to the Microsoft Developer Network CDs, take a close look at the slides from this year's Professional Developers Conference, paying particular attention to SRV-03 and SRV-06. Also, drop by www.iunknown.com to get the latest scoop on building scalable server applications. **PC**

John Lam is the curator of the IUnknown.com Web site. He spends most of his time thinking about, writing about, and teaching COM, IIS, and MTS. He also develops and teaches training courses for DevelopMentor (www.develop.com). To contact him, drop by www.IUnknown.com.

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Create and Solve Word-Ladder Puzzles

PC Ladder creates word games that challenge your vocabulary and ingenuity.

By Neil J. Rubenking

Can you change WHITE to BLACK or HATE to LOVE? PC Ladder can! This issue's utility lets you create, solve, and print "word ladder" puzzles. To solve such a puzzle, you transform a starting word into an ending word (usually an opposite) by changing one letter at a time, using a real word at every step. For example, a FOOL can become WISE: FOOL, POOL, POLL, PILL, WILL, WILE, WISE. Use PC Ladder to create word-ladder puzzles, then solve them on the computer or print paper versions to share with friends and colleagues. The mathematician Charles Lutwidge Dodgson (better known as Lewis Carroll) is credited with inventing this delightful word puzzle.

You can obtain PC Ladder by download from PC Magazine Online or by mail. Refer to the sidebar "Getting the Files" for details. The Delphi 3 source code for PC Ladder is also provided.

USING PC LADDER

Run PC Ladder's installation utility to add the program, the help file, and an uninstall utility to your Start menu. PC Ladder runs under Windows 95, Windows NT 4, and Windows NT 3.51.

At start-up, PC Ladder will select a puzzle at random from your collection—for example, HATE to LOVE in three steps (see Figure 1). Initially the top rung of the ladder will contain the starting word, and the bottom rung will contain the ending word. You can resize the window to change the ladder's height, but its width is fixed.

To enter your guess for the next word in the sequence, click with the mouse on the character column you wish to change or use the Arrow keys to select that column. Now type the new

character for that position. As long as the resulting word is found in PC Ladder's word list, it will appear on the next rung, with the changed letter shown in red. When you fill in the last blank rung correctly, you've solved the puzzle.

There are three ways to delete your most recent guess: Press Backspace, choose *Delete last* from the Action menu, or right-click the ladder and choose *Delete last* from the pop-up menu. Both the Action menu and the right-click pop-up menu also let you clear your attempted solution or reverse the puzzle by exchanging the starting and ending words.

A second group of menu items can help

PC Ladder

PC Ladder lets you create, solve, and print "word ladder" puzzles. To solve such a puzzle, you transform a starting word into an ending word (usually an opposite) by changing one letter at a time.



you make progress when you're stuck. If you can't think of a word that fits, try *Pick word from list*. PC Ladder will display a menu of words that differ by one letter from the most recent guess. If you're still stuck, choose *Show next word* and PC Ladder will tell you the next word—but only if all your previous guesses are correct. And if you get totally frustrated, choose *Show solution* and PC Ladder will reveal its solution to the puzzle.

Sometimes you'll discover that your latest guess can't be linked to the ending word, because the necessary linking strings are not words. Other times you'll find that a particular guess is a dead end, because the number of letters that need to be changed is greater than the number of steps remaining. PC Ladder flags the latter type of dead-end guess internally, but it doesn't tell you about such mistakes unless you put a check next to the *Check progress* menu item. This item is found in the Action menu and also on the right-click pop-up menu. When it's checked, dead-end guesses are flagged with red bullets at the left.

Many ladder puzzles have more than one possible solution. As long as you get from the starting word to the ending word by changing one letter at a time, your solution is valid.

CREATING PUZZLES

PC Ladder comes with a handful of puzzles, but the real fun starts when you create your own. Maybe you'd rather change WHITE to GREEN or BEIGE instead of BLACK. PC Ladder will find a solution quickly or report that no solution is possible. To start, choose *Create puzzle* from the File menu and select the word length. The Create Puzzle dialog will appear (see Figure 2).

Type a starting word, or choose a word from the list. When you press Enter or click the *Next* button below the starting word, PC Ladder will trim the list so it only includes words that can be reached from the chosen starting word. Words in which every letter is different from the starting word are shown in boldface; these make for the most challenging puzzles. Choose an ending word from the list, or type in a word yourself. When you press Enter or click the *Solve* button below the ending word, the program will find the shortest possible solution.

PC Ladder will solve most puzzles in a few seconds, but occasionally you'll find that it takes a longer time. This occurs when the puzzle has a large number of steps and is thus quite difficult to solve. For example, it takes 20 steps to make BABIES SLEEPY and 29 steps to go from BREWING to WHISKEY. To abort the program's search for a solution, just click the *Stop* button.

FOR PROGRAMMERS ONLY PC Ladder is a 32-bit Windows application written with Borland's visual programming tool, Delphi. It compiles under Delphi 2.0 or higher. The source code for PC Ladder is available on PC Magazine's Web site (www.pcmag.com) and demonstrates several programming techniques, including how to:

- find the shortest path between multiply linked list elements;
- use the OnDrawCell event handler to change the look of a Delphi grid control;
- create a pop-up menu with a variable number of items at runtime.

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If you want to create several puzzles in one session, click *Reset* after completing each one. When you press *Close* to dismiss the Create Puzzle dialog, the most recent puzzle will be loaded into PC Ladder.

Some transformations are just not possible. Using the default word list, you can't change EVIL to GOOD. In that case, your best bet is to find a slightly different pair of words; for example, you can change VILE to GOOD.

To print a puzzle, load it into PC Ladder and choose *Print puzzle*. This will produce a printout showing just the starting and ending words, with blanks for the links between. Choose *Print solution* to show the whole word ladder, with the changed letter in each line italicized.



FIGURE 1: PC Ladder challenges you to change the first word to the last, one letter at a time.

EDITING THE WORD LISTS

PC Ladder has five, specially formatted word lists, one for each supported word length. The words in each list are organized into groups such that a word ladder is possible using any two words in the same group, and impossible using words in different groups. The word-list files also define links between each word and all other words that differ only by one letter. Never edit these files directly!

To make changes in a word list, select *Manage word lists* from the File menu, and then select the word length. In the resulting dialog, press the *Export words* button to export the list to a text file. Use your favorite editor to modify the text file, deleting unwanted words and adding new words. When you edit the file, make sure that every line contains exactly one word, that the words are all in uppercase, and that there are no duplicates. The order of the words doesn't matter; you can insert new words wherever you like.

Save your edited word list, then press the *Import words* button to import the file. This part of the process can take quite some time. When processing is complete, you can create puzzles using the new list. Note that after you change the word list, some of your puzzles may have different solutions. For example, using the default word list you need five steps to go from BANG to BOOM; however, if you add BONK to the list, a four-step solution becomes possible. If you find a solution shorter than PC Ladder's, you need to re-create the puzzle using the current word list.

INSIDE PC LADDER

Finding a word-ladder path between two arbitrary words could be a very time-consuming task for a computer. PC Ladder speeds the job by preprocessing the word lists as much as possible. The preprocessing takes time, but it need only be performed when a word list changes. The algorithm PC Ladder

uses to solve puzzles avoids recursion and makes use of the information stored in the word lists to reach the shortest solution as rapidly as possible. PC Ladder's user interface demonstrates a couple of interesting techniques as well. The attractive "wooden" ladder is really just a standard grid component sporting an elaborate OnDraw-Cell event handler. PC Ladder's tech-

nique for building a pop-up menu at runtime is also of interest.

PROCESSING WORDS

PC Ladder preprocesses word lists to speed puzzle solving in real time. If PC Ladder had to search the entire master list repeatedly for one-letter-different words, it would take an absurdly long time. PC Ladder speeds this process by storing links to all the one-letter-different words for each word in the list. It also divides the word list into groups such that two words form a solvable puzzle if and only if they belong to the same group.

After the preprocessing has been completed, PC Ladder writes out the results. Each line in the output file begins with one of the original words. The next three characters are the group number expressed in hexadecimal, followed by a representation of the links to other words.

For example, here's a line from the file of four-letter words:

LOVE@011CDHMRW2AI3BDGNPRS

The word LOVE belongs to group 001. Its first letter can be replaced by C, D, H, M, R, or W (indicated by "1CDHMRW"), its second by A or I ("2AI"), and its third by B, D, G, N, P, R or S ("3BDGNPRS"). Unsuitable words belong to group number 000 and have no links.

To solve the word-ladder puzzles, PC Ladder extracts all words that are one letter different from the starting word, then all remaining words that are one letter different

"HOUSTON, YOU HAVE A PROBLEM."



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from words in the first group, and so on, continuing until it encounters the ending word. Because of the preprocessing of the word lists, only puzzles that *have* solutions are ever attempted.

LADDERING A GRID

Delphi's `TStringGrid` component is an adjustable two-dimensional grid that can hold string data associated with each grid cell. By default, it simply displays each cell's data string, but the programmer can take control of the component's appearance with an `OnDrawCell` event handler. If the `DefaultDrawing` property is `True`, the grid component paints its own grid lines, fixed cells, and cell data before calling `OnDrawCell`. PC Ladder's grid takes complete control over the drawing process, so `DefaultDrawing` is set to `False`.

The solution to the puzzle is stored in the last column of grid cells, and the user's guesses are stored in the first column. The second column holds the index of the character in the current word that differentiates it from the previous word. When PC Ladder detects that a given guess is a dead end with no solution possible, the utility sets the third column to R. If the *Check progress* menu item is checked, then a red bullet will be displayed next to each guess flagged with R.

The ladder sections are all derived from a single 75- by 75-pixel bitmap, which you can see in PC Ladder's About box. The first step for the `OnDrawCell` handler is to identify whether the current cell is one of the four corners, part of one side, or part of a middle rung. It initializes the `TRect` variable `R2` to represent the correct 25-by-25 portion of the ladder bitmap, and the `CopyRect` method of the grid component's `TCanvas` object copies that portion into the current cell.

If the current cell is in neither the first nor the last column, the `OnDrawCell` handler must draw the appropriate letter from the user's

guess, which is stored in the first cell of the same row. It sets the background mode for the canvas to transparent, so as not to wipe out the underlying ladder bitmap. Then the handler draws the character, centered in the cell. If this is the character that differentiates the word from the previous word, it's drawn in red; otherwise, it's black.

Next comes the flagging of impossible guesses. If the *Check progress* menu item is checked, if the current cell is in the first column (the left side of the ladder), and if the third cell in the same column contains the letter R, a red bullet is drawn. Finally, if the

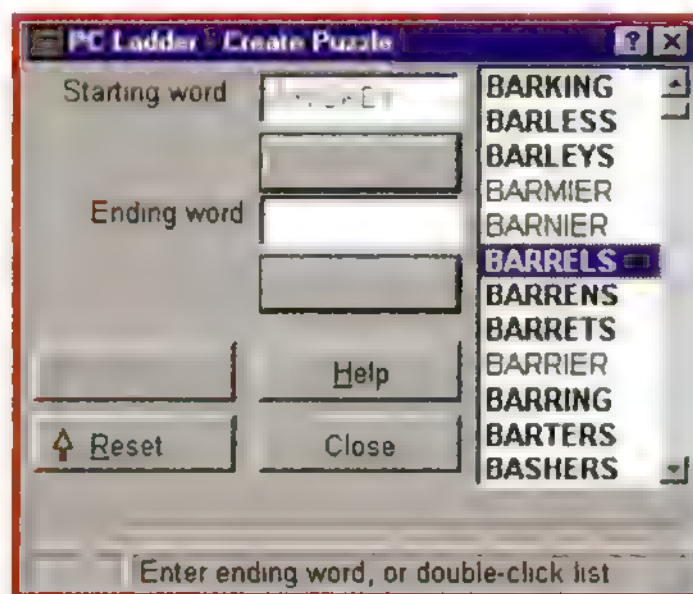


FIGURE 2: Once a starting word is chosen, the word list shrinks to show only ending words for which a solution exists.

cell has focus (is selected), the `OnDrawCell` handler draws a focus rectangle.

The underlying grid component still handles tasks such as receiving keyboard input, recognizing mouse clicks, storing data in cells, and so on. But the `OnDrawCell` handler effectively masks it from view.

A RUNTIME POP-UP MENU

When you choose *Pick word from list*, PC Ladder builds and activates a pop-up menu that contains all the possibilities. The pop-up menu component `pmVariable` exists as part of

the main form's design, but initially it doesn't have any menu items. Just before displaying this pop-up menu, PC Ladder clears any left-over items and adds a new set of items that consists of all words reachable from the most recent guess. Then it reads the link data for the current guess from the length-appropriate word-list file, and interprets this data to create a list of one-letter-different words. This list is stored in a temporary string list named `sl_temp`. After sorting `sl_temp`, it fills `pmVariable` with menu items, adding a column break after every tenth item.

The key here is the little-known `NewItem` function, found in the source file `Menus.pas` but not in Delphi's online help. `NewItem` returns a new `TMenuItem` object based on seven arguments: caption, shortcut key, Boolean values for checked and enabled, `OnClick` event handler, help context, and name. In this case, each item's caption is the word itself, all are enabled but not checked, and all have the same `OnClick` event handler, `VarWordListClick`. The items that are 10th, 20th, and so on, have their `Break` property set to `mbBarBreak`, which results in starting a new column with a vertical separator. The `VarWordListClick` event handler simply adds the caption of the calling menu item as the next guess. Next time you need to display a menu whose contents are determined at runtime, remember the `NewItem` function.

Modern programs, be they business productivity utilities or entertainment software, benefit from a memorable and easily learned user interface. I hope the techniques shown in PC Ladder will inspire you to think about the user interfaces in your own programs. **PC**

Neil J. Rubenking is the author of PC Ladder and a contributing technical editor of PC Magazine. Sheryl Canter is the editor of the Utilities column and a contributing editor of PC Magazine.

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User-to-User

BY NEIL J. RUBENKING

Adding an Extension to an Existing File Type

In Windows 95, once you've defined a file type and its association, adding another extension to that file type isn't easy without going into the Registry. For example, I have set up several actions for the txtfile type, and I often want to add another extension that will be considered a text file. I finally found an easier way to do this. I exported one of the existing extension classes to a REG file, like this:

```
REGEDIT4
```

```
[HKEY_CLASSES_ROOT\.log]
@="txtfile"
```

and I keep the file on my desktop, where it's handy. Now if I want to add a new type, I right-click on this shortcut, select Edit, and change the extension (.log in the example) to whatever I want to add. I save and exit, then run the file. The new extension is now considered a txtfile.

In my opinion, it would make a lot more sense if you could just edit or add extensions in the Explorer View | Options | File Types | Edit dialog. Having to create a new type or edit the Registry to add an extension is ridiculous.

JEFF WILKINSON
via the Internet

PC MAGAZINE: When you define a new association in Explorer, several Registry keys are created. Suppose you enter an extension of .xxx and a description "TheXFile." The Registry will now contain a key HKEY_CLASSES_ROOT\XXX, with a default value "xxxfile." This default value is the name of the file type. Information on opening this type of file is stored in a second key, whose name matches the file-type name—in this case HKEY_CLASSES_ROOT\xxxfile. This file's default value is "TheXFile" (the description entered in Explorer), and its subkeys contain information on the default icon and various actions (open, print, and so forth) that can be performed on this type of file.

Why does Windows use this indirect method for file association? Why not simply associate the actions directly with the file-extension key? In truth, some older programs do exactly that. By separating the file type from the extension, however, Windows 95 permits associating more than one extension with the same file type. For example, the keys

for the extensions .htm and .html both point to the file type htmlfile. This is indeed a handy feature, but unfortunately Explorer's File Types dialog doesn't permit assigning multiple extensions to the same file type.

By modifying the REG file shown here, you can associate any extension with any existing file type. Do bear in mind that the descriptive name shown in Explorer's File Types list is not the file type. In most cases, the file type is formed by stripping the initial period from the extension and appending "file." For example, the default name for the extension .NJR would be njrfile. But not all file-type names follow this default pattern. If you're assigning a new extension to a file type other than txtfile, double-check the file-type name first. Launch REGEDIT, open HKEY_CLASSES_ROOT, and navigate to a key named for an existing extension of the desired type. Now check the right-hand pane to get the correct name for that file type.

Peek Inside EXEs And DLLs

Here's a tip for getting information about EXE and DLL files under Windows 95 or Windows NT, without using an external utility. Suppose you want to know the DLLs needed by an EXE program or the purpose (or functions) of a DLL. A quick and easy way is to use Quick View. This OLE tool included with Win 95 and Win NT lets you view many kinds of documents, including executable files.

When viewing an EXE program, you can see the import table, which shows the DLL modules needed by the program. If you view a DLL, you can look at the exported functions to get an overview of the purpose of the DLL. Just select the file you're interested in and use the Quick View entry on the right-click context menu.

SYLVAIN LAMBERT
Quebec, Canada

PC MAGAZINE: When you right-click an EXE or DLL file and choose Quick View, you're greeted with a rather alarming table containing useless-looking

technical information. If you page down a few screens, though, you'll find the import and export tables (Figure 1) that are described here. You can determine what DLLs a program depends on by looking at the headings in the import table. The list of imported function names is sometimes garbled, but the DLL names themselves are usually clear. Do note that this will only show you dependencies that are hard-coded into the executable file. If the program loads a DLL at runtime, that dependency won't show up in Quick View (or in any other utility that analyzes an EXE file in order to find dependencies).

Unless you're a programmer, you won't generally care what functions a DLL exports. However, if you're trying to decide whether or not to delete a "mystery DLL," looking at the function list may help you decide. For example, if the DLL's function names all relate to a program that you've deleted, you can probably delete the DLL as well.



FIGURE 1: Quick View, a utility in Windows 95 and Windows NT, provides some useful information about EXE and DLL file dependencies.

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#28420	550CDT	266 MMX*	32	4.0GB	20X	12.1" TFT	\$3,879
#28073	750VD	233 MMX*	64	4.7GB	—	13.3" TFT	\$5,329
#24693	750CDM	233 MMX*	32	4.0GB	—	13.3" TFT	\$4,939

Portégé Series

Order#	Model	Pentium® processor*	RAM	HD	CD	Display	Price
#97053	300CT	133 MMX*	32	1.6GB	—	10.4" TFT	\$1,949
#28419	320CT	266 MMX*	32	3.8GB	—	10.4" TFT	\$3,599

Libretto Series

Order#	Model	Pentium® processor*	RAM	HD	CD	Display	Price
#97049	50CT	75MHz	16	810MB	—	6.1" TFT	\$999
#24678	70CT	120MMX*	16	1.6GB	—	6.1" TFT	\$1,949

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#99913	TP380ED	166MHz MMX*	16	2.1GB	20X	12.1" DSTN	\$1,699
#28626	TP380X	233MHz MMX*	32	3.2GB	20X	12.1" HPA	\$2,379
#99915	TP380ED	166MHz MMX*	16	3.0GB	20X	12.1" TFT	\$2,699
#28627	TP380XD	233MHz MMX*	32	4.0GB	20X	12.1" TFT	\$3,149
#28625	TP380XD	266MHz MMX*	32	5.1GB	20X	12.1" TFT	\$4,549

ThinkPad 560

Order#	Model	Pentium® processor*	RAM	HD	CD	Display	Price
#28622	TP560X	200MHz MMX*	32	2.1GB	—	12.1" HPA	\$2,379
#99041	TP560	166MHz MMX*	16	2.1GB	—	12.1" TFT	\$2,849
#11247	TP560X	233MHz MMX*	32	4GB	—	12.1" TFT	\$3,429

ThinkPad 770

Order#	Model	Pentium® processor*	RAM	HD	CD	Display	Price
#99904	TP770	200MHz MMX*	32	3.2GB	—	13.3" TFT	\$3,599
#99906	TP770	233MHz MMX*	32	4.0GB	—	13.3" TFT	\$4,189
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#11641	PLUS 4350X	150 MMX*	16	2.1GB	20X	12.1" TFT	33.6Kbps	\$1,549
#97985	PLUS 4360X	166 MMX*	16	2.1GB	10X	12.1" TFT	33.6Kbps	\$1,799
#28399	PLUS 5260	166 MMX*	16	2.1GB	20X	12.1" TFT	56Kbps	\$1,699
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#97427	200MHz MMX*	32	3.2GB	16X	MT	\$1,249
#97428	233MHz MMX*	32	3.2GB	16X	DT	\$1,349
#14643	P1 233MHz MMX*	32	3.2GB	16X	DT	\$1,499
#14641	P1 266MHz MMX*	32	3.2GB	16X	DT	\$1,699
#14637	P1 300MHz MMX*	32	3.2GB	16X	MT	\$1,999

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#14693	200MHz MMX*	32	1.6GB	—	DT	\$999
#14691	233MHz MMX*	32	2.1GB	—	DT	\$1,149

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#97441	166MHz MMX*	32	3.2GB	16X	MT	\$1,399
#97442	200MHz MMX*	32	2.4GB	—	DT	\$1,199
#14631	P1 233MHz MMX*	32	2.4GB	—	DT	\$1,449
#97421	233MHz MMX*	32	3.2GB	16X	MT	\$1,499
#14633	P1 233MHz	32	3.2GB	16X	MT	\$1,649
#14627	P1 266MHz	32	3.2GB	16X	DT	\$1,829
#14636	P1 266MHz	32	3.2GB	16X	MT	\$1,849
#14625	P1 300MHz	32	3.2GB	16X	DT	\$2,099
#27833	P1 333MHz	32	3.2GB	16X	DT	\$2,349

Pentium® processor with MMX technology.



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Order#	Model	Pentium® processor*	RAM	HD	CD	Price
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#99888	656234U	200MHz MMX*	32	2.5GB	—	\$1,299
#99886	656236U	200MHz MMX*	32	4.2GB	—	\$1,259
#99884	656238U	200MHz MMX*	32	4.2GB	24X	\$1,379

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#15126	628278U	200MHz MMX*	32MB	2.5GB	16X	\$1,239
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#94064	1560DM	133MHz	16	1.4GB	10X	12.1" TFT	\$2,149
#14704	1540DM	150MHz MMX*	16	2.1GB	20X	12.1" CSTN	\$2,199
#26785	1560DM	166MHz MMX*	16	3.1GB	20X	12.1" CSTN	\$2,449
#97388	1580DMT	133MHz MMX*	16	2.1GB	10X	12.1" TFT	\$2,699
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Order#	Model	Pentium® processor*	RAM	HD	CD	Display	Price
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#99536	7350MT	166MHz MMX*	32	2.1GB	—	12.1" TFT	\$3,349
#24711	7360DMT	200MHz MMX*	32	3.0GB	20X	12.1" TFT	\$3,799
#24712	7370DMT	233MHz MMX*	32	4.0GB	20X	12.1" TFT	\$4,599
#26787	7380DMT	266MHz MMX*	32	4.0GB	20X	12.1" TFT	\$4,999
#26788	7380DMT	266MHz MMX*	32	4.0GB	20X	12.1" TFT	\$4,999

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Order#	Model	Pentium® processor*	RAM	HD	CD	Display	Price
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#94062	7730MT	166MHz MMX*	32	2.1GB	—	12.1" TFT	\$3,349
#94046	7750MT	166MHz MMX*	32	2.1GB	—	12.1" TFT	\$3,549
#24713	7790DMT	233MHz MMX*	32	5.0GB	20X	13.3" TFT	\$4,799
#23932	7770DMT	233MHz MMX*	32	3.0GB	20X	12.1" TFT	\$4,999
#26790	7792DMT	266MHz MMX*	32	5GB	20X	13.3" TFT	\$5,549
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#99512	8014	200MHz MMX*	16MB	2.1GB	—	—	\$899
#99513	8017	233MHz MMX*	32MB	3.2GB	—	—	\$1,079

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Ask Our Advisors

HARDWARE

The Ravages of Time

What is the best method for archiving computer files for the long term? I have ruled out any magnetic medium such as floppy disk or tape, because these are subject to deterioration with time and need to be refreshed. I am leaning toward CD-ROM for its low media cost, high capacity, and robustness, but I wonder how permanent these disks might be. I realize that CDs that are mastered and produced in bulk should be fairly permanent, but what about the recordable CDs? Can we be sure that a disk will still be reliable in five years' time?

PETER BRADSHAW
via the Internet

PC MAGAZINE: The first issue has to be a definition of terms. "Long-term" storage could involve hundreds of years or more; five years would be a fairly short length of time on that scale. Let's assume that you have data that you want to keep safely for five to ten years. The question of the storage medium is certainly an important one, but there are also hardware and software concerns to consider as well.

In terms of media, you may have ruled out magnetic media too quickly. It is true that tightly wrapped magnetic tape can cause the fields on one layer to affect the next, leading to a degradation of the stored data, but the effects are slight and slow. This is not a problem at all for disk-based media; according to some floppy disk manufacturers, the data should remain accessible indefinitely. There have been widely published reports about the physical media deteriorating on magnetic-media audio archive tapes, but these problems occurred after decades, and modern materials have much better storage attributes. So removable magnetic media—with either floppy or rigid disks—may be entirely appropriate for your needs.

CD-ROMs are manufactured with the data physically embedded within the disks. It is not practical to create the master disk required for this process when you're only making one or two copies, which is where the recordable CDs, or CD-R disks, come into play. These use a light-sensitive dye to alter the reflectivity of a layer of gold (or some similar metal) within the layers of the blank disk. According to the Optical Storage Technology Association, unrecorded disks should have shelf lives of five to ten years. Once they are recorded, however, the data should be safe for much longer.

An ANSI committee is working out guidelines for how CD-R life spans should be mathematically estimated; some manufacturers currently rate the disks' media to last for 70 to 200 years. The major caveat here is that the disks must be stored and handled carefully to avoid heat or physical damage.

No matter which media you should decide to use, there are other problems to consider. First and foremost, what hardware will you use in five or ten years to retrieve the data? Ten years ago, most computers used 5.25-inch floppy disk drives; today, they can be difficult to find. And 15 years ago, some personal computers used 8-inch floppy disks (such as the Radio Shack Model II); when was the last time you saw one of those drives working? Advances in storage designs strive to maintain backward compatibility, such as the LS120's ability to read 1.44MB 3.5-inch floppy disks and DVD drives' ability to read CDs, but you can't count on that to hold true across multiple generations of hardware. So if this data is critical, you should maintain a reference machine that is physically capable of reading the data.

You will also need software support. If your data is stored in straight ASCII text format, then you stand an excellent chance of being able to access it with future applications. If the data is stored in a proprietary format, however, such as a database or word processing format, then you cannot count on future versions of the program being able to read the data—or even on an operating system being able to access the information. How would you handle a Magic Pencil file on a Super-Brain CPM floppy disk, for example? Again, the only sure solution is to maintain a reference system that can read the stored data.

In the final analysis, you may want to create a parallel archive on old-fashioned paper. This will give you the opportunity to recover the data if your machine-readable solutions should fail, and you'll be able to use OCR (optical character recognition) to scan and reenter the data in a future system, if necessary. This might be a cheap insurance policy for protecting the data over long periods of time.—Alfred Poor

OPERATING ENVIRONMENTS

Windows 95 CD Player

On my home computer running Windows 95, I have entered the artist names and audio tracks from almost all my audio CDs. I'd like

to use the same database on my machine at the office. Is there an easy way to do this?

ALAIN BEAULIEU
via the Internet

PC MAGAZINE: The Windows 95 CD player stores its artist, title, and track information in the file Cdplayer.ini. If you have CD data on one system and not the other, simply copy that file from one system to the other. If you have collected different CD data on the two systems, just append the contents of one Cdplayer.ini to the other and use the combined file on both systems.

You may be interested in a \$10 shareware program called EasyCD2, from GHL Software. EasyCD2 can locate and download artist, title, and track data for almost any audio CD from the Internet. You'll find EasyCD2 at www.ghlsoftware.com.—Neil J. Rubenking

WORD PROCESSING

Slashed Zeros in Word

I've recently switched to Microsoft Word, using both Word 7 and Word 97, and I'm looking for a way to create a slashed zero, so that I can easily distinguish between a zero and the letter

OUR ADVISORS

Alfred Poor is a contributing editor and the author of *The Underground Guide to Hardware*.

Brian Proffitt is a contributing editor of *Computing Today* and the author of *OS/2 Warp Survival Kit*.

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M. David Stone is a contributing editor and the coauthor of *Word for Windows Companion, Second Edition*.

CDW

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440CDT 133/MMX 16MB 1.34GB 12.1" AM 10X	1549.46
460CDX 166/MMX 32MB 2GB 12.1" DS 10X	1679.47
470CDT 200/MMX 32MB 2.1GB 12.1" AM 10X	2857.45
480CDT 233/MMX 32MB 3.8GB 12.1" AM 10X	3397.56
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520CDT 166/MMX 32MB 3.8GB 12.1" AM 10X	3047.89
530CDT 166/MMX 32MB 3.8GB 12.1" AM 10X	3277.49
550CDT 266/MMX 32MB 3.8GB 12.1" AM	3847.83
730CDT 150/MMX 16MB 2GB 12.1" AM 10X	2167.66
740CDT 166/MMX 16MB 3GB 13.3" AM 10X WIN NT	2997.15
740CDT 166/MMX 16MB 3GB 13.3" AM 10X	2787.59
750CDT 233/MMX 32MB 4.7GB 13.3" AM 20X	4794.85
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391T 150/MMX 16MB 2.1GB 12.1" AM 20X	1637.86
392T 166/MMX 32MB 3GB 12.1" AM 20X	2127.86
TravelMate notebooks	
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2030CX 200/MMX 48MB 3.1GB 13.3" AM 16X	2897.38
2035CX 233/MMX 32MB 3.1GB 13.3" AM 20X	2887.62
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3015EX 233/MMX 32MB 2.1GB 14.1" AM 20X	3367.74
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735DS 133/MMX 16MB 1.6GB 12.1" DS 20X	1387.23

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OfficeConnect ISDN LAN modem	306.96
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SuperStack II Hub 24-port 10BT	850.04

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Combo EtherPCI LAN card	49.17
Combo PC/Ethernet card 10BT	69.07
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StackPro 8-port 100BTX desktop hub	299.09
StackPro 16-port 100BTX rackmount hub	499.86

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Ethernet hub	42.26
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Backup Exec for Windows NT V7.0	
enterprise edition version upg	364.29
Backup Exec for Windows NT V7.0	
single-server edition	428.17
Backup Exec for Windows NT V7.0	
enterprise edition	799.86
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25-user single-server edition	367.58

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EtherEZ ST 10BT hub	48.82
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Kensington Orbik	49.69
Logitech MouseMan for notebooks	44.95
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Microsoft IntelliMouse V3.0	82.97

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Agfa ePhoto 1280 digital camera	828.33
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digital camera	199.00
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Epson Expression 836XL	849.00
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photo scanner	399.00
Hewlett-Packard ScanJet 5	
scanner	199.28
Hewlett-Packard ScanJet	
5100cse scanner	299.00
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Minolta DiMAGE Scan Dual	659.99
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UMAX Astra 1200S w/PhotoShop LE	274.97
UMAX Mirage lite w/MagicScan	299.00
Visioneer PaperPort mtr	139.55
Visioneer PaperPort Strobe	249.99

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BJC7000	349.00

EPSON

Stylus Color 400	179.00
Stylus Color 600	249.00
Stylus Color 800	349.00
Stylus Color 1520	799.00
Stylus Color 3000	1999.00
Stylus Photo	309.00



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HP DeskJet 672C color printer	199.00
HP DeskJet 694C color printer	239.00
HP DeskJet 722C color printer	299.00
HP DeskJet 890Cse printer	399.00
HP DeskJet 1000Cse color printer	399.00
HP LaserJet 5Si printer	2436.03
HP LaserJet 6Lse printer	399.00
HP LaserJet 6MP printer	877.26
HP LaserJet 6Pse printer	799.00
HP LaserJet 4000se printer	1149.00
HP PhotoSmart photo printer	309.89

LEXMARK

Color Jetprinter 1000	139.02
Color Jetprinter 7000	347.80
Optra E+	367.36
Optra S 1250	999.94
Optra S 1650	1104.15
Optra S 2450	1979.48
Optra SC 1275	3307.77

OKIDATA

Okuljet 2020	199.00
Okpage 4w	199.00
Okpage 6e	299.00
Okpage 16n	699.00

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MAG InnoVision DJ700 17" 0.28mm	515.93
MAG InnoVision DJ800 19" 0.28mm	788.84
NEC MultiSync E500 15" 0.25mm	336.52
NEC MultiSync E700 17" 0.25mm	668.17
NEC MultiSync E1100 21" 0.28mm	1059.80
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Philips Magnavox CM218A 21" 0.28mm	897.43
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Princeton E590 19" 0.28mm	729.99
Samsung SyncMaster 500e 15" 0.28mm	255.00
Samsung SyncMaster 700e 17" 0.28mm	469.00
Sony Multiscan 100es 15" 0.25mm	327.70
Sony Multiscan 200es 17" PnP 0.25mm	605.80
Sony Multiscan 300el 20" PnP 0.30mm	1129.58
ViewSonic E771 17" 0.27mm	389.54
ViewSonic G773 17" 0.26mm	499.00
ViewSonic GS771 17" 0.27mm	469.00
ViewSonic G790 19" 0.26mm	773.27
ViewSonic G810 21" 0.25mm	999.87

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3Com Ethernet adapter w/JACK	107.80
3Com 32-bit Fast EtherLink XL CardBus	147.57
3Com LAN PC Card combo	169.88
3Com 33.6K w/JACK	169.99
3Com 33.6K cellular w/JACK	214.66
3Com 33.6K cellular	214.66
3Com 33.6K 10BT LAN-modem	259.18
3Com 33.6K 10BT LAN-modem combo	299.83
3Com 56K w/JACK	214.66
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Hayes ACCURA 56K	179.52
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Simple 33.6K cellular	149.53
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Modems

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O. In WordPerfect 6.0, I used to create a slashed zero using an overstrike command. Is there an equivalent choice in Word?

JERRY TROJCAK
via the Internet

PC MAGAZINE: There are at least two ways to fake a slashed zero in Word, if you don't have a font that offers one. Word won't recognize either as a true zero for calculations, which is why I refer to them as "faked." But if all you're looking for is an easy way to distinguish between a zero and the letter O in a list of serial numbers or the like, either will do the job.

The easiest approach is to hit Ctrl-/ then Shift-O to enter an uppercase O with a slash through it. This is ANSI character number 216, a variation on the capital O alphabetic character. The result will look pretty much like a slashed zero, except that it will be a bit wider in most fonts.

If the difference in size bothers you, the other choice is to use the equation field to define an overstrike. To create the field, hit Ctrl-F9 to insert the two field characters, represented by boldface open and close curly braces. Word leaves the cursor between the two markers. Type the equation field so the field code looks like this: {eq \0 (0, /) }. The eq in this field code identifies it as an equation field. The \0 switch (using the letter O) is the command to overstrike the characters within the parentheses that follow. The two characters to overstrike, of course, are the slash and the zero. Be careful not to leave any spaces between the right parenthesis and the right curly brace. If you do, the spaces will be added to the field as extra characters.

After you've entered the text, while the cursor is still between the two curly braces, hit F9 to update the field. If you have Word set to the defaults, you'll see the field change to a slashed zero. If it continues to show as a field code, hit Alt-F9, which toggles Word between showing field codes and showing field results. Make sure that the field shows just one character, without any trailing spaces.

This second approach will give you a better-looking slashed zero, but it takes more work. To make it easier, you'll want to define it as an AutoText entry. After creating the slashed zero, select it. That can be a little tricky. Unless you've changed Word's default options, whenever you place a cursor in a field, the field will be highlighted. That may look as if the field is selected, but it's not. To select the slashed zero, you can move the cursor to it so it becomes highlighted, then hold the Shift key down and hit the Right Arrow key once. Alternatively, you can click on it to select it.

The procedure from this point on is slightly different in Word 7 and Word 97. In Word 7, choose *Edit | AutoText*. Word opens the AutoText dialog box with the slashed zero already entered in the *Selection* box. Enter an appropriate abbreviation in the *Name* box and choose *Add* to create the AutoText entry, then close the dialog box. Note that the abbreviations /0 or 0/ won't work. But the abbreviation doesn't matter, because you won't be using it anyway, as you'll see in moment.

To test the entry, type the abbreviation (with a space before it), then F3. Word expands the abbreviation to a slashed zero. But there is still one problem. If you type the abbreviation within a larger number, so that some character other than a space is to its left, Word won't recognize it. If you type 10 and then F3, for example, you'll get an error message.

The final step to making this easy to use is to attach the AutoText entry to a keystroke. Alt-0 (zero) is a good choice, since it's easy to remember and the shortcut isn't attached to any Word command by default. To attach the entry to Alt-0 in Word 7, choose *Tools | Customize*, then *Keyboard*. Go to the *Categories* list and highlight *AutoText*, then go to the *AutoText* list and highlight the abbreviation for the slashed zero. Then move to the *Press New Shortcut Key* box and press Alt-0, which will show up in the text box as "Alt+0." Choose the *Assign* button, then *Close* to close the dialog box. You should now be able to enter the slashed zero by typing Alt-0, even in the middle of a word or number.

In Word 97, the mechanics are virtually identical, but some keystrokes and the names of some text boxes are different. To create the AutoText entry, choose *Insert | AutoText | AutoText* to open the AutoCorrect dialog box with the AutoText tab chosen. The slashed zero will be entered in the *Preview* box. You need to enter the abbreviation in the *Enter AutoText Entries Here* box. When you're done, choose *Add* to create the AutoText entry and close the dialog box. As with Word 7, you can then test the entry by typing the abbreviation, then F3.

Note that the abbreviations /0 or 0/ will work in Word 97, and they will work even if you start them without a preceding space. You may still want to attach the entry to a keystroke, such as Alt-0, for easier typing. Follow the same steps as in Word 7. The last step for both versions of Word, finally, is to make sure you save changes to the Normal template, where the AutoText entry and key assignment are stored. In Word 7, choose *File | Save All*. In Word 97, close the program, and answer *Yes* if it asks you whether to save changes to *Normal.dot*.—M. David Stone

SPREADSHEETS

Inserting Excel Sheets

Lotus 1-2-3, Release 5, has a file-combining feature that allows you to open a Lotus file from disk straight into your current file, thus eliminating the extra steps of opening the disk file separately and copying the contents to the clipboard and then to the current file. Is there any way to do this in Excel?

KEN STIFF
via the Internet

PC MAGAZINE: Excel has no direct equivalent to 1-2-3's *File Combine* command, but there are simple ways to put together two Excel files. If you don't fancy using the Clipboard, you can drag and drop. Display both Excel files—the one you're copying from and the one you're copying to—at the same time. Make both files visible at once, either by sizing their windows manually or by using the *Window* menu's *Arrange* command. Then select the data you want to copy, hold down the Ctrl key, put your cursor on the edge of the selected block (so that the mouse pointer becomes an arrow), and drag to the other file. If you want to move the data instead of copying it, don't hold down the Ctrl key.

You can use the same technique to copy or move entire pages. In that case, all you have to do is drag the page tabs. If you drag a tab from one file to the page-tab area at the bottom of a second file, you can position the incoming tab exactly where you want it—say, between Sheet1 and Sheet2 of the target file. If you just drag the tab onto the target worksheet, Excel chooses a spot for the incoming page.

Another way to combine files is with the *Insert Object* command. Choose *Object* from the *Insert* menu, click the *Create from File* tab, type the name of the file you want to insert (or click the *Browse* button and point to the file in the browser dialog box), click *Insert*, and then click *OK*. What you get this way is an object that behaves a little differently from ordinary worksheet data. The object is surrounded by a border with white handles, and if you move your cursor within the object, you'll find that you can't edit cells in the normal manner. But if you double-click anywhere in the inserted object, you'll get normal editing functionality. When you've finished editing, choose *Close and Return* from the *File* menu.

This object-insertion method may seem like a clumsy way to put files together, but it has virtues. You can change the position or size of an inserted object by dragging it or one of its white handles. You can even display the entire file as an icon (select the *Display as*

PCTech Ask Our Advisors

Icon check box in the Insert Object dialog box when you insert the file). This is a great way to make ancillary information available but unobtrusive. Those who want to see the details can double-click on the icon. Those who are not interested can read right over the icon. Finally, you can use the *Insert Object* command to insert a copy of a file that's linked to its original, so that if the original changes, the copy keeps in step. To do this, select the *Link to File* check box in the Insert Object dialog box.

In Excel 97, a good alternative to inserting an object and displaying it as an icon is to create a hyperlink. Choose *Hyperlink*, not *Object*, from the Insert menu. Type the path of a file on the *Link to File* line, or click *Browse* and point to the file. You'll get a link that looks and behaves exactly like a link on a Web page. Clicking the link brings up the file to which it points.

Finally, if you decide to use the Clipboard after all, here's a handy tip. Open both files (the source and the destination). Copy data from the source file to the Clipboard. With the source file still open, go to the destination file and paste. If you close the source file before pasting, Excel can paste only unformatted text. You can save yourself the trouble of recreating fonts, borders, shading, and formulas by leaving the source file open while you do the paste.—Craig Stinson

DATABASES

Printing a Telephone Directory from Access 97

I am trying to produce a telephone directory for my organization using Microsoft Access 97. I'm trying to get a format having multiple columns on each page, preferably with separating lines between columns. How can I print data in this format?

CHARLIE CAULFIELD
Fremont, California

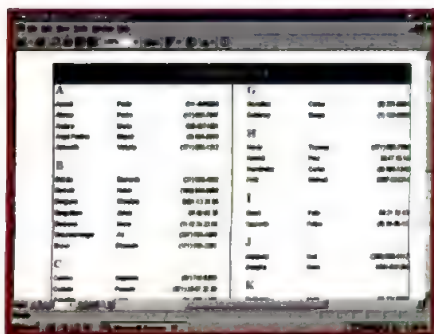


FIGURE 1: The telephone-list report shown here was created using the report designer in Microsoft Access 97 and the code shown in Figure 2.

```
Private Sub Report_Page()  
Dim x1, y1, x2, y2 As Integer  
  
' Draw a border around the page  
Me.Line (0, 0)-(Me.ScaleWidth, Me.ScaleHeight), , B  
  
' Set the coordinates and draw a line down the middle of the page  
x1 = Int(Me.ScaleWidth / 2) ' Middle of the page  
y1 = Me.Section(acPageHeader).Height ' Start just below pageheader  
x2 = x1 + 1 + Me.DrawWidth  
y2 = Me.ScaleHeight  
Me.Line (x1, y1)-(x2, y2), , B ' Draw the line  
  
End Sub
```

FIGURE 2: This code, placed in the report's Page event, draws a border around the report and a line down the middle of the page.

PC MAGAZINE: Figure 1 shows a sample telephone list that I created using Microsoft Access 97. You start by opening the Report Wizard to generate a report. After you choose the fields for the report, such as *LastName*, *FirstName*, and *Telephone Number*, the wizard will ask if you want to add a grouping level. Choose the *LastName* field, then choose the *Grouping Options* button, and set *Grouping Interval* to *1st Letter*. That tells the wizard to generate a report in which Access will start a new group whenever the first letter of the last name changes. Thus, all of the A's will be grouped together, followed by all of the B's, and so on, just as you'd expect in a telephone listing. When the wizard asks what sort order you want for the detail records, choose the *LastName* field first and the *FirstName* field second, so that the records will appear sorted within each group. Then finish generating the report.

To change the report to a multiple-column format, select the File menu, choose *Page Setup*, and then select the *Columns* tab. Here you must choose the number of columns needed and provide the other information Access needs to format the columns correctly. For the example shown in Figure 1 I chose two columns, but if you're willing to reduce the page margins and accept a smaller typeface, you can easily fit four columns of snaking column text in a report. You'll find a four-column example in the sample database that's available for downloading from PC Magazine Online.

While in the Page Setup dialog, be sure to set the *Column Width* and *Column Layout* properties to meet your needs. You'll probably have to experiment with these settings until you're satisfied with the results. Choose *OK* when you're finished.

To draw a border around the page and lines between the columns, you can use the code shown in Figure 2. The code uses the *Line* method to do the drawing and should be

placed in the report's Page event. The Page event is the best place in a report to make last-minute changes to the appearance of a page, because it is called after Access has completed all other formatting, when the page is about to be sent to the printer.

To add the code, first make sure the report is open in design mode. Next, select the Edit menu and choose *Select Report*. Then, select the View menu and choose *Properties*. Next, select the *Event* tab and locate the report's *On Page* property. Click the *On Page* property, then click the ellipsis (...). Then, in the Choose Builder dialog, which results, choose *Code Builder*, and press *OK*. Finally, type in the code as it appears in Figure 2, being careful not to duplicate the *Private Sub* and *End Sub* lines. Then choose *File | Close* to save your changes.

The two-column example shown in Figure 1 and a four-column example not shown here are available for downloading from www.pcmag.com. Look for the file named *Teleph.mdb*.—Sal Ricciardi

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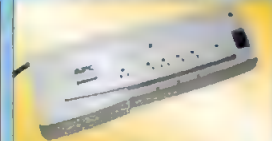
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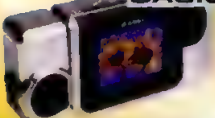
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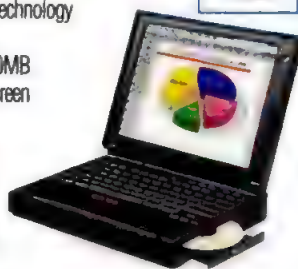
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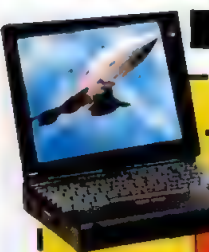
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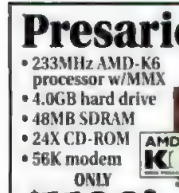
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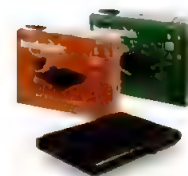
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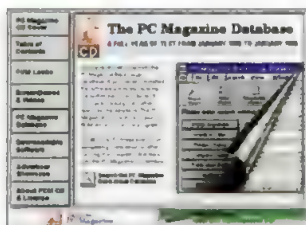
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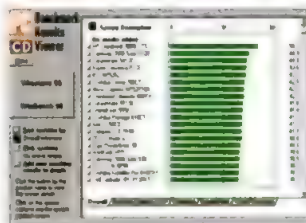
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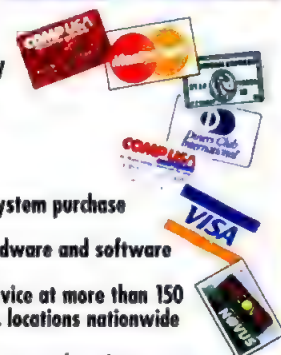


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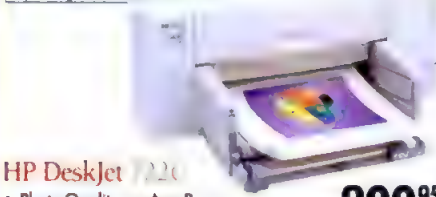
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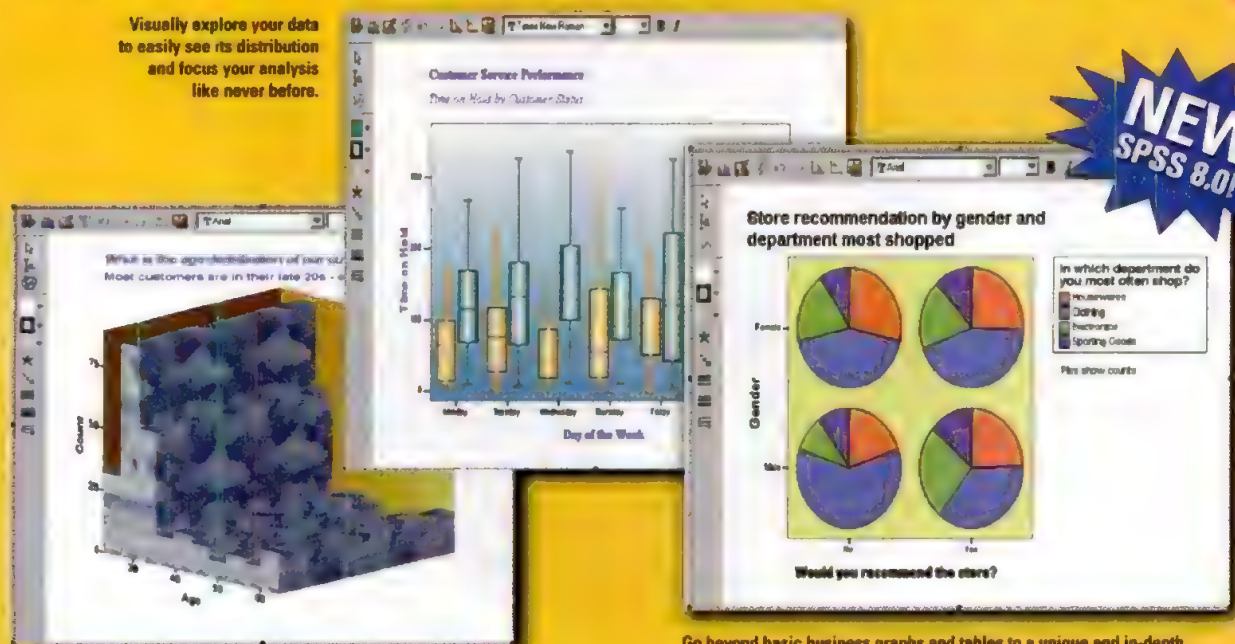
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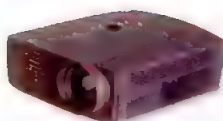
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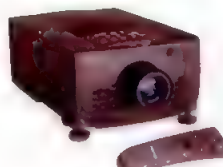


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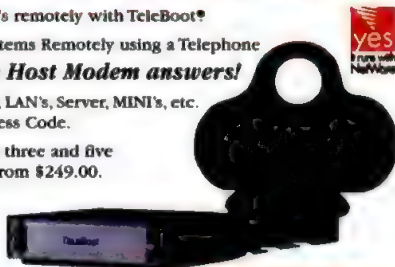
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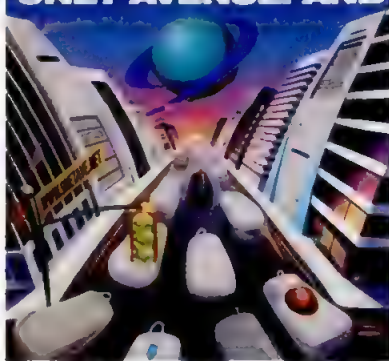
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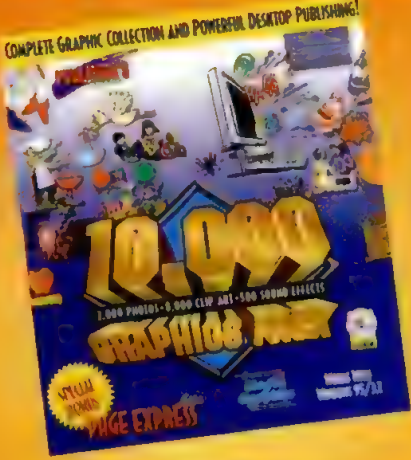
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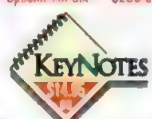
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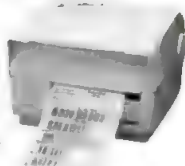


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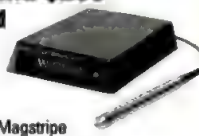
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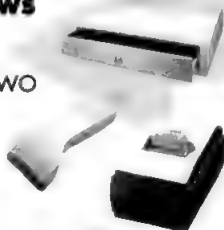
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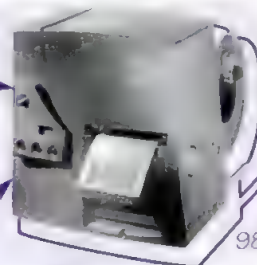


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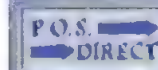
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Branching Out

Genealogy software can help you find your roots.

Genealogy is such a popular hobby in America that dozens of stores, magazines, and conventions are dedicated solely to this pursuit. It's no wonder then that genealogy software, which helps you trace and compile your family tree, is so popular.

There are basically two types of genealogy programs: those that help you organize and store the family tree data you have already researched and those that aid in the search for your family's roots (through the use of Social Security records, the Internet, and genealogical agencies) and map out a tree for you.

We reviewed the most recent versions of five titles. Three of these—Family Heritage Deluxe, Family Tree Maker Deluxe Edition III, and Ultimate Family Tree Deluxe—incorporate research tools, while the remaining two, Create Family Trees Quick & Easy and Legacy 2.0, help organize and display your information. A sixth release, Generations Deluxe from Sierra On-Line, was scheduled to debut in March but was not available in time for testing.

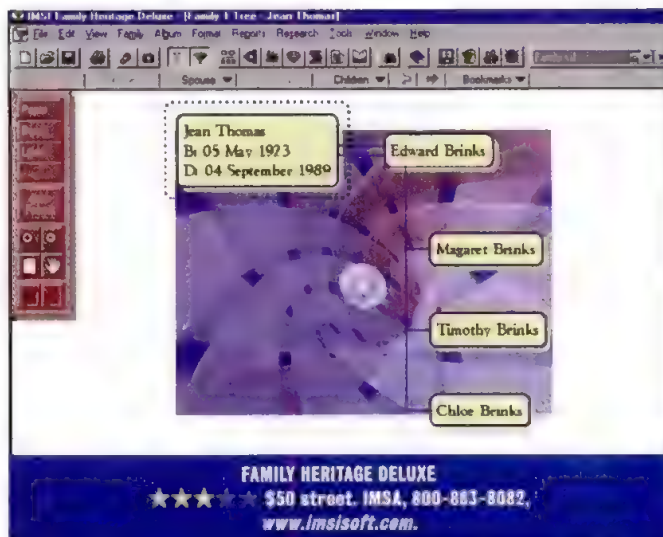
Create Family Trees Quick & Easy

As the name implies, family trees are simple to create with Individual Software's

Create Family Trees Quick & Easy. At the budget price of \$20, the program focuses on information storage, not research.

Entering data is straightforward, as each family member gets an individual worksheet containing fields for oodles of information. From names to dates and places of birth, death, baptism, marriage, divorce, bar mitzvah, graduation—it can all be entered here. The program is also GEDCOM-compatible, making it easy to import data from other genealogy programs.

On-screen, data is arranged in a horizontal tree view. In



printed copy, not on-screen.

The software allows you to find a relationship between two members by simply highlighting both names and clicking on the Show Relationship tool button. Although we liked this ability, we found that the program was not capable of

finding relationships through marriage. But search options are impressive. In addition to the usual text search, you can build complex searches such as "find all people born in the United States before 1960." In the next release, we'd like to see the user have the ability to save these searches.

We ran into some difficulty printing large trees with heavy detail on our HP LaserJet printers, but the vendor claims it will have a patch available by the time you read this.

This program lacks the bells and whistles of others in this roundup, but if you already have a lot of information and

need to get it organized, Create Family Trees Quick & Easy may be just the tool you're looking for.—Diane Jecker

Family Heritage Deluxe

This program may seem familiar to some, since it was previously released as Corel Family Tree Suite. It incorporates three elements: a genealogy program, Corel Photo House (for adding photos to your family tree), and Family Publisher (which among other things lets you publish your tree

INSIDE

A PC ROMANCE

Romeo and Juliet come to the 20th century via CD-ROM. *Page 288.*

AHEAD OF THE 8 BALL

Virtual Pool 2 offers all the fun of a real billiard hall. *Page 288.*

FANTASY PLAY

Get ready to battle the undead in this exciting strategy game. *Page 292.*



addition to names and dates, digital photos can be added to the trees. We were disappointed, however, that the program was able to accept graphic files only in BMP, GIF, and PCX formats—and even then you can see the photos only on a

After Hours

on the Internet).

To begin building your family tree, you enter data into individual forms or directly into the graphical tree layout—something you can't do with most other programs. Fact and figure entry is simple enough in the clean, intuitive interface.

We were hampered, however, by a few of the product's quirky tendencies. For example, when we tried to enter "05/23/1929" as a birth date, the program repeatedly translated the date to "May 1923/1929." Then it told us we could not enter 1956 as a wedding date, because this date preceded the May birth date given. Although the program accepted other birth dates and wedding dates without a hitch, this was a frustrating hiccup.

The research tools packaged with the program are fairly extensive, including the Social Security Death Index, covering 50 million people; the Ancestry's Red Book, a directory of resources; The Source, a genealogical reference book; and a comprehensive collection of information and links on the manufacturer's Internet site.

Without a doubt, Family Heritage Deluxe allows you to make the most beautiful family trees and charts of any of the programs in this roundup. There are hundreds of backgrounds, borders, and fonts gleaned from the manufacturer's MasterClips and MasterPhotos programs, as well as the photo enhancement capabilities of Corel Photo House. In addition, you can add family photos and video to your trees.

If presentation is the most important factor for you, Family Heritage Deluxe is your choice.—Jennifer Triverio

Family Tree Maker Deluxe Edition III

It seems as if Broderbund Software's Family Tree Maker products have been around as long as genealogy itself. Okay, not quite, but they are the granddaddy on the block and a longtime best-seller. Now the question: Does established mean best? In this case, yes. The combination of ease of use, layout and printing options, and research capabilities makes Family Tree Maker Deluxe Edition III the logical choice for helping to discover and organize your family history.

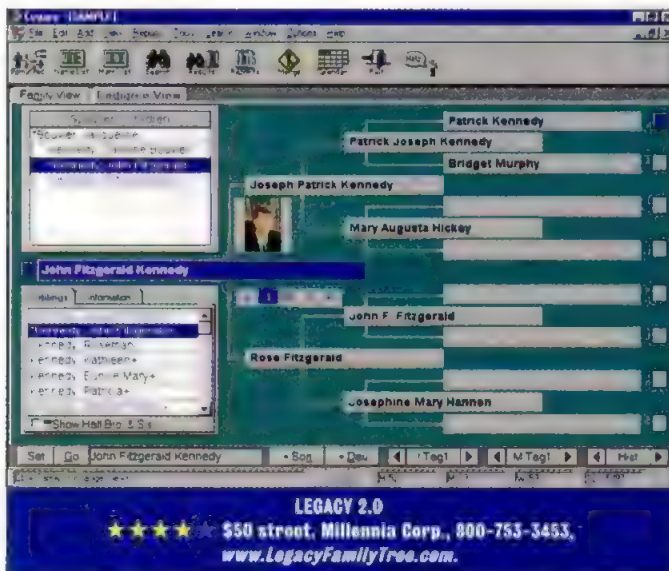
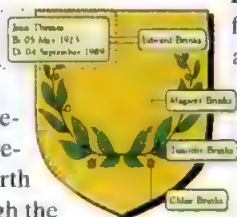
The program features tabbed sections that let you easily navigate between sections of the data entry forms and between individuals.

You can also add photos to the huge array of tree layouts and reports that the program generates. An interesting side benefit is that you can create calendars, address labels, and name tags using the information you've input.

From ancestor and descendant trees to scrapbook pages and paginated family albums complete with a table of con-

tents, Family Tree Maker Deluxe gives you dozens of ways to display and save your genealogical information.

disks shipped with the program contain 27,000 completed family trees, with links to 15 million people (additional



The research, perhaps this product's best feature, is also the one that can be the most overwhelming, based simply on the sheer size and scope of the information presented. In addition to the usual Social Security Index, this product contains Family Finder Index, which references 130 million people listed by birth, death, marriage, and census, ranging from the 1600s to the present. The five World Family Tree

resource disks are sold for \$20 to \$50 each).

The program is ultracomprehensive, and the corresponding Web site is an invaluable tool as well.—JT

Legacy 2.0

If you've already done the legwork and gathered all your family background (or as much as you could find), then Legacy 2.0 is the program to help you compile, organize, and display your hard-earned data. A real boon for the serious genealogist, this program forgoes most of the frills of the other programs and concentrates on charts, reports, and forms compliant with genealogical society standards.

Data entry in Legacy is simple and straightforward: The individual input form includes room for vital information plus an unlimited number of events, notes, and pictures. The data can be viewed in either Family or Pedigree view, and the program can use this information to create literally dozens of reports. These



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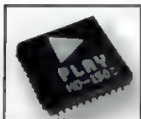
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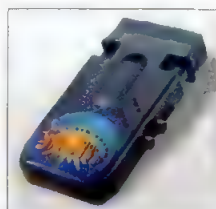
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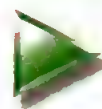
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After Hours

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Windows 95

None

✗ ✗ ✗

✗

Powerful search engine

✗

✗



Family Heritage Deluxe

\$50

Windows 95

Ancestry's Red Book Directory, Social Security Index, The Source Research Guide, Swyrich Coats of Arms, Swyrich Surname Histories

✓ ✓ ✓

✓

MasterClips backgrounds, borders, and photos

✓

✓



Family Tree Maker Deluxe Edition III

\$85

Windows 3 x 95

Family Finder Index, Social Security Index, World Family Tree

✓ ✓ ✓

✓

Family Archive CDs

✓

✓



Legacy 2.0

\$50

Windows 3 x 95

None

✗ ✗ ✗

✗

IntelliMerge

✗

✗



Ultimate Family Tree Deluxe

\$60

Windows 3 x 95, Mac OS

Social Security Index

✓ ✓ ✓

✓

One free professional genealogy search included, World Photo Studio

✓

✓

include the typical ancestor and descendant charts as well as relationship diagrams, time lines, surname summaries, census forms, and family history books (complete with tables of contents and indexes).

Legacy can import and export files from GEDCOM and PAF-compatible programs. (GEDCOM stands for Genealogical Data Communications, a file-format standard used throughout the genealogy field. PAF, or Personal Ancestor File, is an older file-format standard.) And while the program can support a large number of graphics file formats, there is unfortunately no support for importing a photo directly from a scanner.

Invariably, while researching and acquiring facts and figures for your family tree, you'll come across two different data sheets for the same person. Perhaps one document seems more up-to-date regarding marriages and divorces, but you're sure the birth and death information you have is solid. With Legacy, you can merge the two docu-

ments using the IntelliMerge feature and choose which data you want to keep.

Legacy is a solid program offering intuitive yet advanced functions for genealogy buffs. —JT

Ultimate Family Tree Deluxe

A strong rival for the genealogy software crown, Ultimate Family Tree Deluxe offers some nifty features, but it falls just a little short of Family Tree Maker Deluxe with

regard to ease of use and research tools.

If you are just getting started in your quest to track down your past, be sure to view the 30-minute tutorial, which introduces you to various types of records and charts and gives you pointers on how to conduct your historical research. When you are ready to begin entering your data into the index card-style individual

information forms, you are instructed by the manual to choose the Help Wizard and follow its on-screen instructions. While the wizard is indeed helpful, it would be less tedious if the forms were more intuitive and you didn't need the wizard at all.

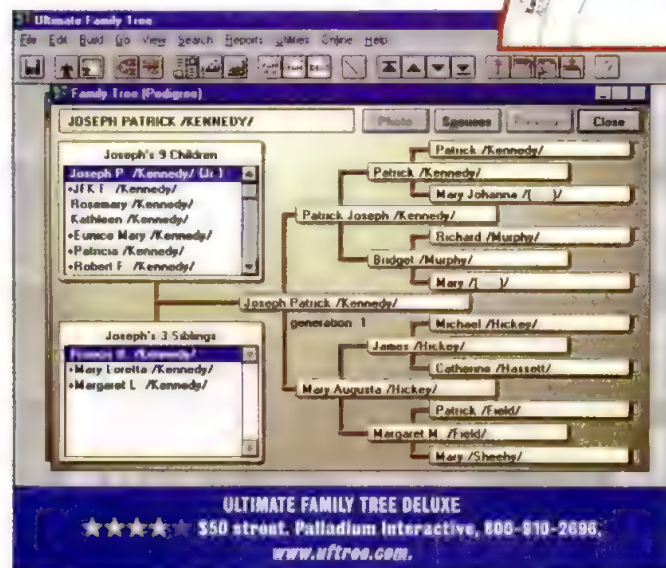
After you've tracked down and entered your data—with the assistance of the included Social Security Index, the free professional search that's provided, and the research databases hosted on the company's Internet site—Ultimate Family Tree goes the extra distance to insure that you'll have a highly presentable family tree or book. The Family Album Maker portion of the program lets you organize and use photos, scanned documents, and video clips to create print collages and photo albums. The 1,600 maps, flags, and photos in the World Photo Studio allow you to customize and spruce up your albums.

Of course, albums and collages aren't the only things you can create with the program.

A vast array of tree layouts and reports can be generated from the data you've input.

And while the program does come with a tutorial for beginners, it is worth noting that once you are comfortable with Ultimate Family Tree Deluxe's features, you can switch from Normal to Advanced editing mode, which gives you access to lesser-known and lesser-used charts in addition to more in-depth editing functions.

Ultimate Family Tree Deluxe offers a great value for the dollar and proves to be a worthy entry to the genealogy field. —JT



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O Romeo, Romeo

A new study aid brings the words of Shakespeare to life for teens.

Remember reading Shakespeare in high school—or trying to? Great stories, once you figured out how to leap across the 400-year cultural gap. *Romeo+Juliet*, from Stratford Studios, aims to remedy this problem by using games, interactive studios, and a full audio performance of the play to draw students in and keep them interested. Despite occasionally choppy sound and a sometimes annoying tendency to try to be cool, this CD-ROM proves absorbing and should be helpful to young scholars.

As you begin the program, you're greeted by Lester, an animated jester who serves as a help and navigation guide.

He leads you to three main sections: Screenplay, Games, and Studio.

In Screenplay, you can select any scene from the play and hear it performed by the Marin Shakespeare Company. Though some of the players sound more like Keanu Reeves than Sir John Gielgud, this section is invaluable: Shakespeare's meaning is far easier to grasp when heard than read. Other help includes Myrna, the "director," who sets up the scene for you; Dr. Wacko, who contributes criti-

cal observations; and the Screening Room, where four teenagers deliver amusing

whether events happened before, during, or after Shakespeare's lifetime. Unfortunately,

though you get extra points for fast answers, the audio cuts off or skips when you answer quickly—a jarring effect.

The third section, Studio, lets you choose the costume, hair-style, and ethnicity of each character and decide on your ideal cast. Best of all for nascent creative types, an interactive module,



takes on the action. ("It's just so tragic!" "Yeah!")

After listening to the play, you can proceed to the five games, which test your knowledge of the play, of literary devices, and of history—

Script Doctor, helps you write a sequel to this famous tragedy.

Motivated students will have fun with *Romeo+Juliet* and come away with a deeper appreciation for the play —Carol Mangis

Rack 'Em Up

Chalk up your cue and bank a shot into the corner pocket with Virtual Pool 2.

Billiards is accessible to the athlete and the couch potato, the young and the old. It is this everyman appeal, along with the ultrarealistic look, physics, and game play, that made *Virtual Pool* a classic. And now we have the unexpected sequel, *Virtual Pool 2*, which takes the game one step further.

While not much ink is spilled hyping the graphics of a pool game, rest assured that the detail in this title is fantastic. The balls are as realistic as you're ever going to get, with light sourcing that accurately reflects off their shiny sur-



faces. And that's without enabling 3-D acceleration. The game runs on a Pentium/90-based PC, but a Pentium/

166 is recommended.

Virtual Pool built its reputation on realistic physics, and believe it or not,

Virtual Pool 2 is even better. Balls carom, bounce, and roll just as they would in real life. You can control how much English to apply, how hard you hit, and how much draw you put on the cue ball. As if that weren't enough, you can even jump balls and call your shots. And it's not just the balls that are realistic: the table is as

well. The game gives you the ability to adjust almost everything from table speed to rail cushioning, allowing you to re-

create your favorite real-world table on your desktop.

But this game isn't just for pros. VR Sports saw to it that everything was provided for the beginner as well as the pool maven. There are on-screen rules for all nine games, along with a new instructional video from pool guru Mike Sigel that tells you everything you need to know, from basic play to advanced strategies.

We found a few glitches in the game, but only after we switched over to 3-D-accelerated mode. The problems consisted of melding graphics and occasional lockups. However, the game looks so good in normal mode that there's really no need to change. Considering how rewarding this game is and the money-back guarantee, we'd say it's time to stop waiting and give *Virtual Pool* a try.—Shane Mooney

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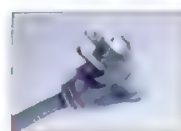
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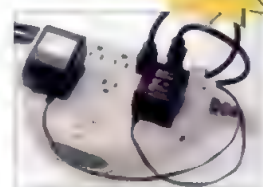
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After Hours

Hard-Core Warfare

Bungie's stunning new strategy game is wonderful to look at but frustrating to play.

A breath of fresh air in the real-time strategy genre, Bungie Software's *Myth: The Fallen Lords* employs a revolutionary 3-D graphics engine and serves up a heaping dose of frenetic action. Unfortunately, the game is extremely difficult and will probably frustrate casual game players.

Myth is a fantasy game in which you command a force of warriors and archers against an army of undead creatures. The game runs under Microsoft Windows 95 and requires a Pentium/133-based PC or better with at least 16MB of RAM. We recommend a Pentium/200 with 32MB of RAM or a Pen-

tium/133 with 32MB of RAM and a 3Dfx-based 3-D accelerator card.

Commanding your troops in *Myth* is relatively simple: You select units with the mouse, then arrange them into a variety of formations or give them a destination or a target. To turn a unit, you first select it and then flick the mouse in the desired direction as you let go of the button—a highly unintuitive process.

Equally frustrating are the level objectives. Though each of the game's 25 levels is intro-

duced by a briefing, you are never really given a clear picture of your goal. Also, the game throws seemingly endless waves of bad guys at you, even on the simplest of five difficulty settings.



Despite these shortcomings, *Myth* can be very entertaining. The game's 3-D terrain is not only spectacular to look

at, it also adds a true sense of depth to the battlefield. The art and animation are excellent, as are the sound effects. Parents should be warned, however: This is a violent and graphic game that lives up to its "Ages 17+" rating.

The game boasts an impressive array of multiplayer options, including free Internet play on Bungie's game server and support for TCP/IP, AppleTalk, modem, and serial links. It's also available on the Total Entertainment Network.

If not for the intense difficulty, *Myth* would become a classic. As it stands, the game should still appeal to dedicated fans of action-oriented strategy games.—
Michael E. Ryan

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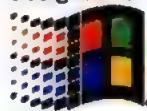




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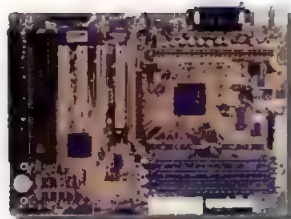


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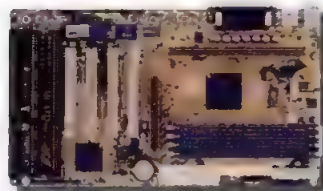
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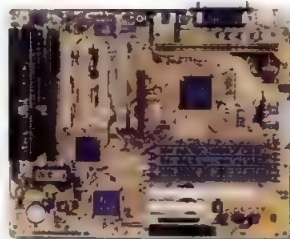
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It seems as if the whole world is on e-mail now, and in some ways it is. But the volumes of mail and pitfalls of communicating over the Internet can overwhelm even the most inspired user. We give you an overview of how to get control of your e-mail, plus two roundups to help you pick the right products.

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What's the best e-mail client to use in your home? How about in a business setting? We test 16 POP3/IMAP-compliant e-mail clients and show you which is the best in each situation.

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On the business side of things, if your company has decided it's time to adopt standards-based e-mail, we help you choose a server package. We also help you decide whether you should go with the full-blown groupware approach—and we review the major groupware packages as well.

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Whether you're just setting up your first Web server or it's time to set up your next one, check out our annual exhaustive testing of many of the current packages on the market. We extend our review beyond just Wintel solutions so you can choose a combination that really suits your requirements.



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The caption  says, "Their eyes met"—but we think he's actually getting a better look at her split ends. (Intel Create & Share Camera Pack ad.)

Notes from the Zine Scene

Check out *The Finger* (www.thefinger.com), which specializes in pointing out pop-culture absurdities. See what happens, for example, when its editors use the Web to translate the lyrics to "I Got You Babe" into German and back: "They say that our love will not pay the rent. Before it is gained, very our money spent. I obtained the baby to you. I obtained baby to you."



Yet Another Year-2000 Crisis

"Washington—The Agriculture Department has set a goal of resolving the snafu expected to derail its comptuers when the calendar reaches 2000—but it does not expect to have its plan ready until 2002."—*NEWSDAY*



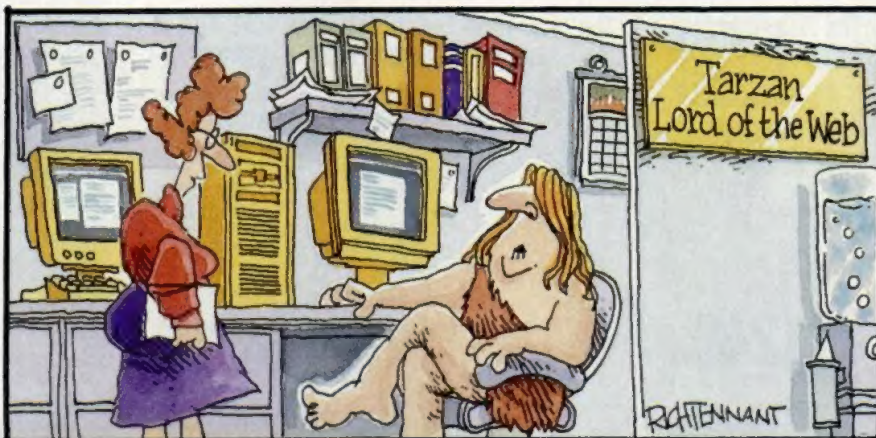
 Here's a Web site that left us scratching our heads.

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"...and then one day it hit Tarzan—Lord of Jungle—where future in that?"

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